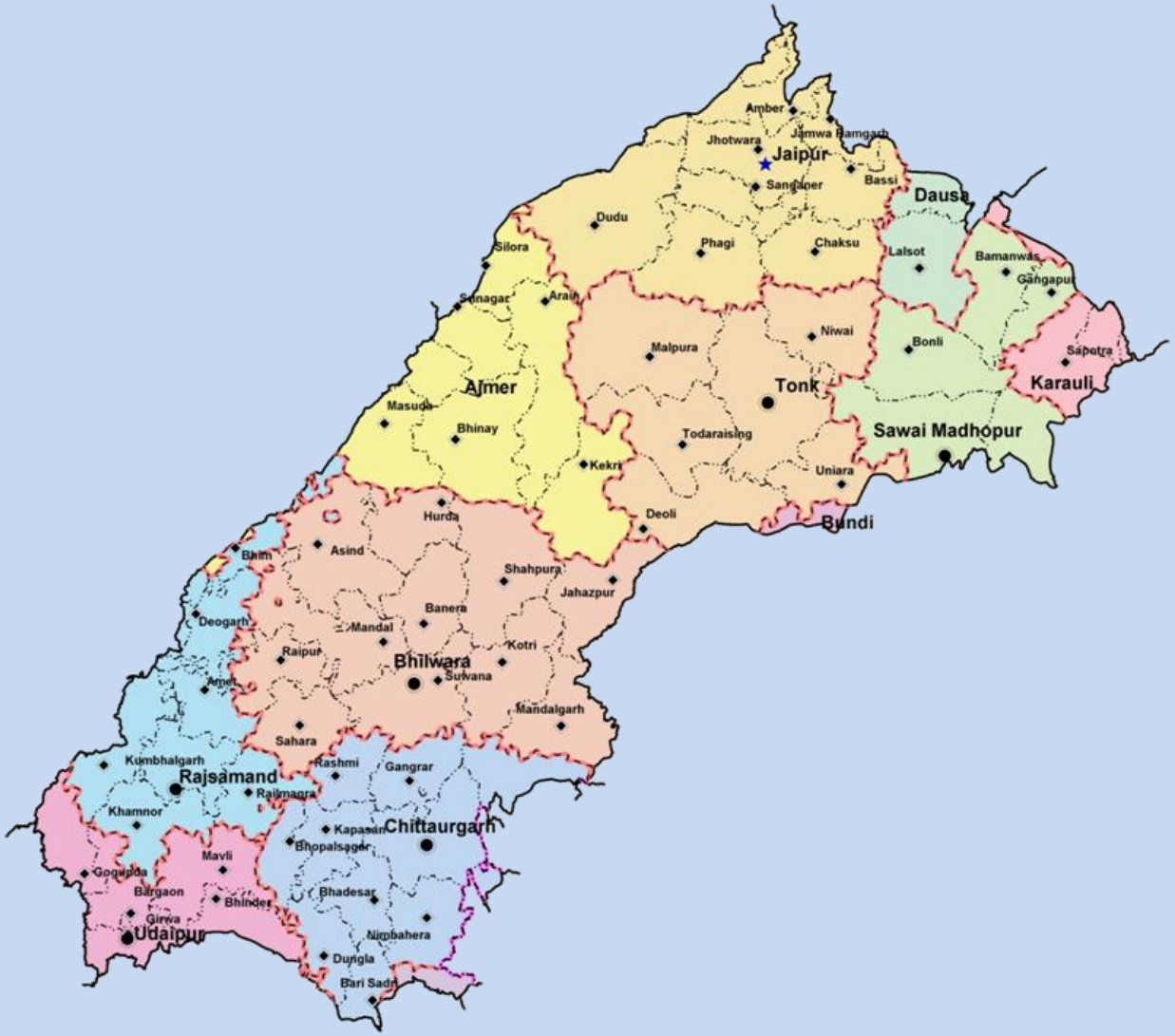
Ground Water Department,
Rajasthan

European Union
State Partnership Programme

Hydrogeological Atlas of Rajasthan

Banas River Basin



2013

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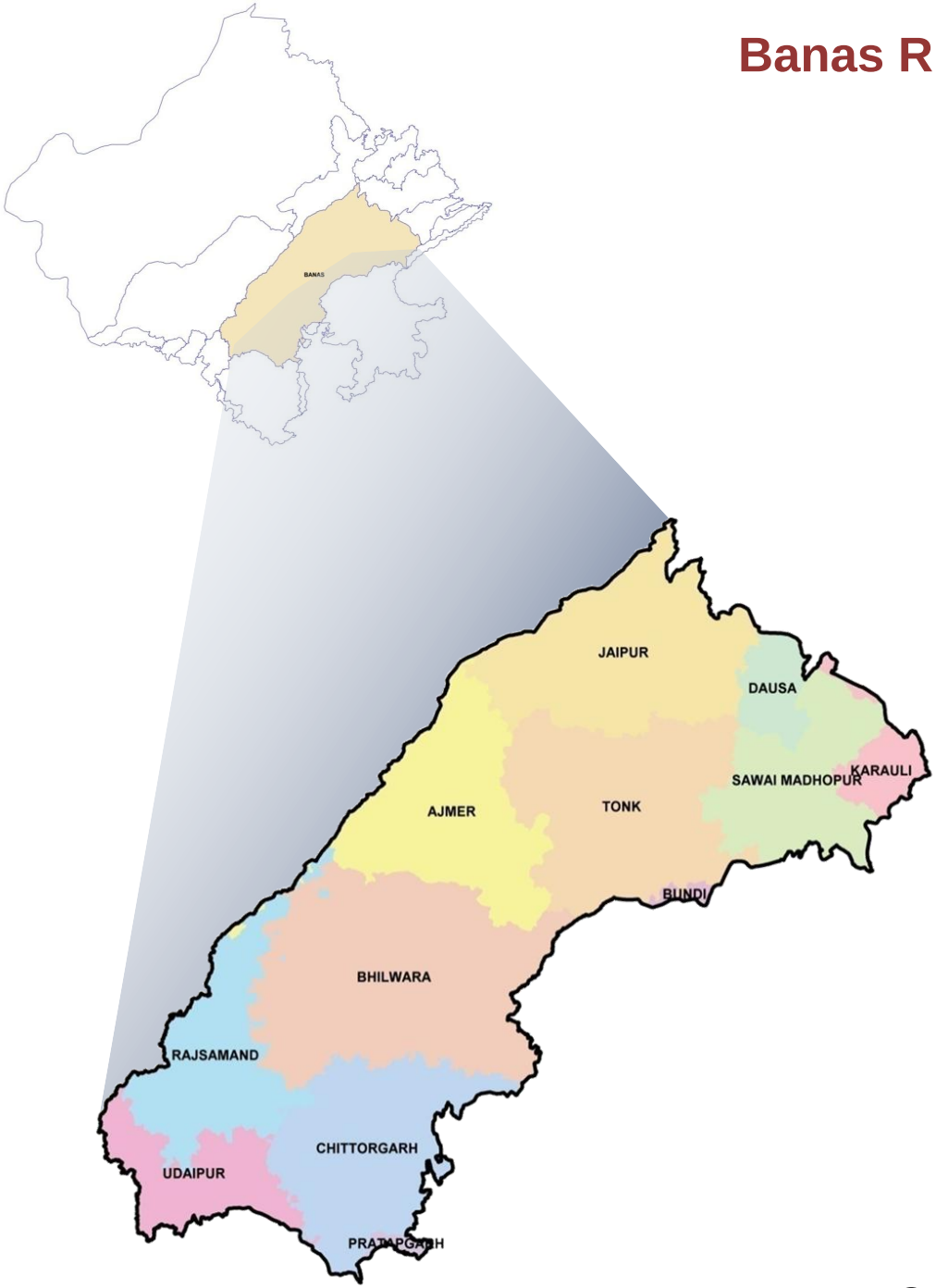
Hydrogeological Atlas of Rajasthan

Banas River Basin



Contents:

2013

ADMINISTRATIVE SETUP

BANAS RIVER BASIN

Location:

Banas River Basin is located in eastern part of Rajasthan and occupies significant area in the east of Aravali mountain range. It stretches between 24° 17' 14.22" to 27° 18' 15.24" North latitude and 73° 20' 54.84'' to 77° 00' 36.49''East longitudes. It is bounded in the east by Chambal river basin, in the north by Gambhir and Banganga river basins, in the west by Shekhawati and Luni river basins and in the south by Sabarmati and Mahi river basins. It is a tributary to Chambal River, which in turn flows into Yamuna River. Originating in the Khamnor Hills of the Aravali Range, about 5 km from Kumbhalgarh in Rajsamand District the Banas River flows for its entire length through Rajasthan only. It flows northeastwards through Mewar region of Rajasthan, meets the Chambal river near the village of Rameshwar in Khandar Block of Sawai Madhopur District. Major right bank tributaries include Berach and Menali whereas the left bank tributaries are Kothari, Khari, Dai, Dheel, Sohadra, Morel and Kalisel. Total length of the river is approximately 512 kilometers.

Administrative Set-up:

Administratively, the basin extends over parts of Ajmer, Bhilwara, Bundi, Chittorgarh, Dausa, Jaipur, Karauli, Pratapgarh, Rajsamand, Sawai Madhopur, Tonk and Udaipur districts encompassing 78 Blocks and 8,511 towns and villages.

S. No.	District Name	Area (sq. km)	% of Basin Area	Total Number of Blocks	Total Number of Towns and Villages
1	Ajmer	5,547.4	11.8	9	625
2	Bhilwara	9,397.2	20.0	12	1,534
3	Bundi	166.3	0.4	1	29
4	Chittorgarh	5,450.8	11.5	13	1,269
5	Dausa	1,185.7	2.5	3	431
6	Jaipur	6,504.8	13.8	11	1,314
7	Karauli	1,113.2	2.4	3	161
8	Pratapgarh	177.3	0.4	1	29
9	Rajsamand	4,208.7	9.0	8	950
10	Sawai Madhopur	3,834.6	8.2	5	642
11	Tonk	6,744.4	14.3	6	1,015
12	Udaipur	2,669.0	5.7	6	512
Total		**46,999.4**	**100.0**	**78**	**8,511**

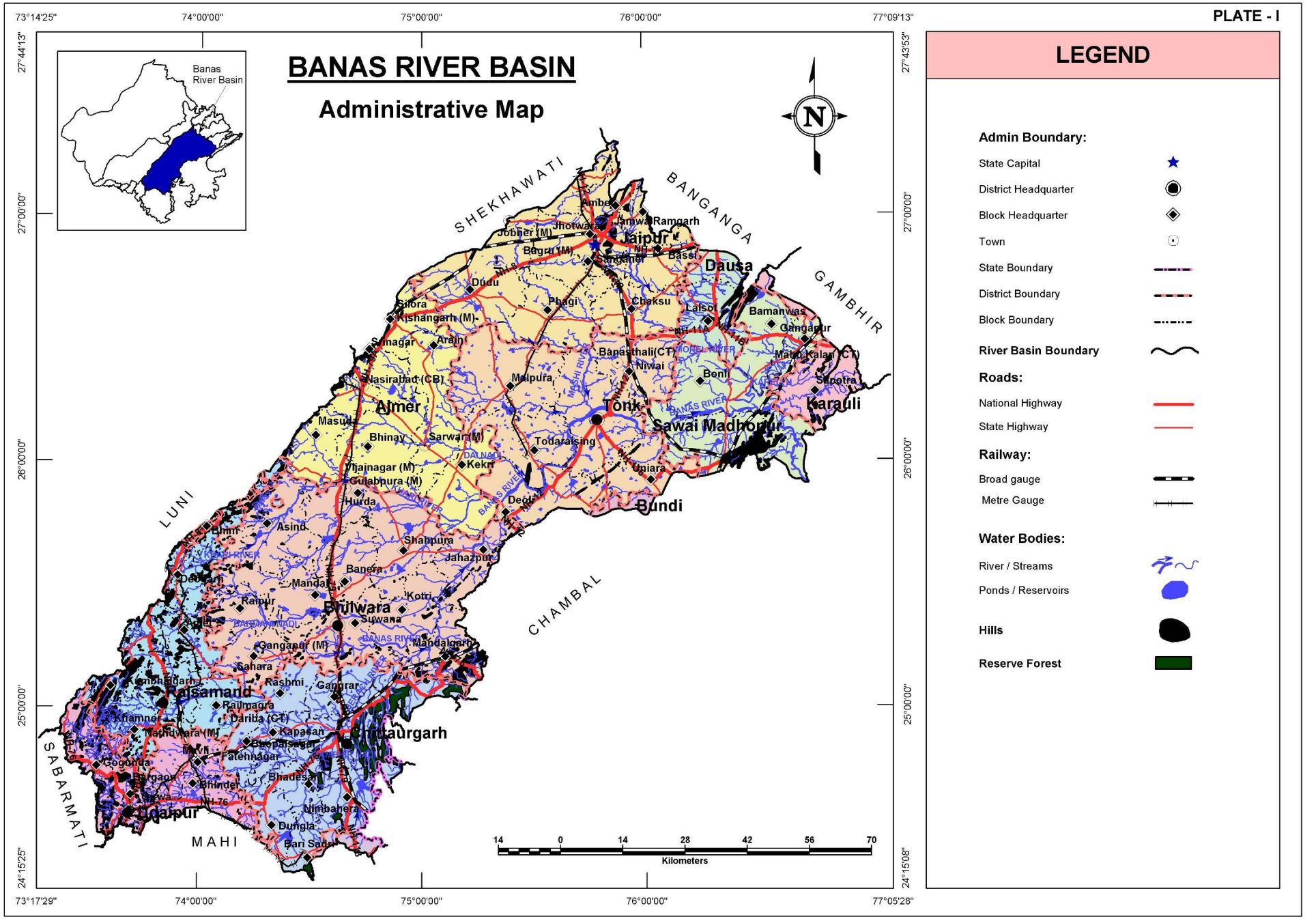
Climate:

Climate of Banas river basin is by and large, sub-humid and had received about 803 mm of average total annual rainfall in the year 2010. Winter sets in in the month of October and lasts till February while warmer period turning hot extends from March to July. The basin receives good rainfall during the four Monsoon months (July-September). Large tracts of the basin are suitable for agriculture practices.

Ground Water Department, Rajasthan

European Union
State Partnership Programme

PLATE - I



LEGEND

Admin Boundary:

- State Capital
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **River Basin Boundary**

Roads:

- National Highway
- State Highway

Railway:

- Broad gauge
- Metre Gauge

Water Bodies:

- River / Streams
- Ponds / Reservoirs
- **Hills**
- **Reserve Forest**

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TOPOGRAPHY

BANAS RIVER BASIN

The western part of the Basin is marked by hilly terrain belonging to the Aravali chain. East of the hills lies an alluvial plain with a gentle eastward slope. Ground elevations in the western hilly part range approximately from about 850 m above mean sea level (m amsl) to about 1,291 m amsl, while the alluvial plain elevations range approximately from 450 m amsl to 176 m amsl where river meets the river Chambal.

Table: District wise minimum and maximum elevation

District Name	Min. Elevation (m amsl)	Max. Elevation (m amsl)
Ajmer	300.6	794.6
Bhilwara	306.6	824.5
Bundi	274.0	321.8
Chittorgarh	352.0	616.4
Dausa	238.0	544.7
Jaipur	271.1	786.2
Karauli	202.1	521.8
Pratapgarh	462.4	566.8
Rajsamand	450.8	1,287.7
Sawai Madhopur	176.0	541.8
Tonk	238.8	608.3
Udaipur	450.5	1,291.1
Ajmer	300.6	794.6
Bhilwara	306.6	824.5

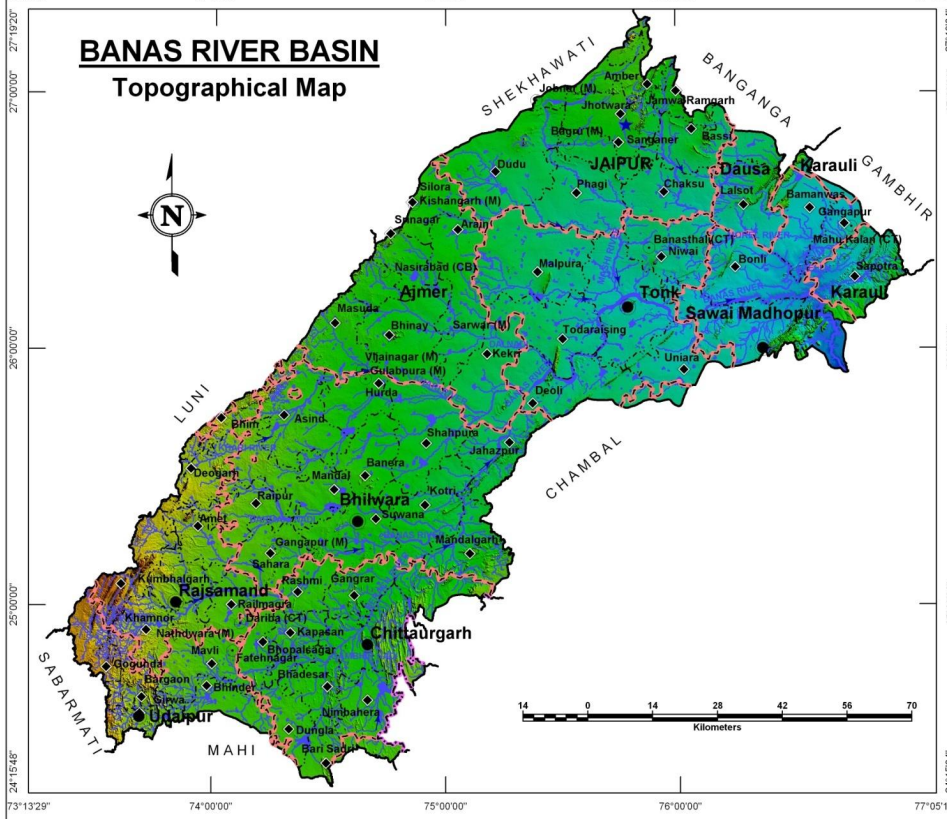
RAINFALL

The general distribution of rainfall across the Banas River Basin can be visualized from isohyets presented in the Plate – III, where most of the basin appears to receive good rainfall that is more than 1000 mm of total annual rainfall in northeastern and southwestern parts. Other areas to the west of Bhilwara and east of Tonk receive less rainfall. The rainfall data for available rain gauge stations for the year 2010 is presented below.

Table: District wise total annual rainfall (based on year 2010 meteorological station recordings (http://waterresources.rajasthan.gov.in)

S. No	Rain gauge Stations	Total Monsoon Rainfall (mm)	Total Non-Monsoon Rainfall (mm)	Total Annual Rainfall (mm)
1	Amber	656.0	75.0	731.0
2	Amet	503.0	147.0	650.0
3	Arain	691.0	135.0	826.0
4	Asind	316.0	150.0	466.0
5	Bamanwas	626.0	116.0	742.0
6	Banera	684.0	162.0	846.0
7	Barisadari	464.0	105.0	569.0
8	Bassi	848.0	97.0	945.0
9	Bhadesar	945.0	135.0	1,080.0
10	Bhilwara	478.0	159.0	637.0
11	Bhim	472.0	230.0	702.0
12	Bhinai	768.0	160.0	928.0
13	Bhopalsagar	448.0	69.0	517.0
14	Bonli	467.0	127.0	594.0
15	Chaksu	813.0	115.0	928.0
16	Chittaurgarh	775.0	92.0	867.0
17	Deogarh	532.0	220.0	752.0
18	Deoli	707.0	135.0	842.0
19	Dudu	504.0	123.0	627.0
20	Dungla	626.0	92.0	718.0
21	Gangapur	710.0	88.0	798.0
22	Gangrar	470.0	76.0	546.0
23	Gogunda	882.0	164.0	1,046.0
24	Hurda	596.0	318.0	914.0
25	Jahajpur	624.0	111.0	735.0
26	Kapasan	677.0	109.0	786.0
27	Karauli	945.7	231.9	1,177.6
28	Kekri	554.5	157.0	711.5
29	Khandar	619.0	170.0	789.0
30	Kotri	708.0	174.0	882.0
31	Lalsot	1,032.0	95.0	1,127.0
32	Malpura	715.0	112.0	827.0
33	Mandal	525.0	138.0	663.0
34	Mandalgarh	758.0	72.0	830.0
35	Mavli	750.0	180.0	930.0
36	Nathdwara	746.0	209.0	955.0
37	Nimbahera	806.0	85.0	891.0
38	Niwai	437.9	81.0	518.9
39	Phagi	678.0	132.0	810.0
40	Railmagra	564.0	139.0	703.0
41	Rajsamand	855.0	184.0	1,039.0
42	Rashmi	559.0	96.0	655.0
43	Sahada	576.0	196.0	772.0
44	Sanganer	651.0	99.0	750.0
45	Sapotara	572.0	141.0	713.0
46	Sawai Madhopur	918.0	207.0	1,125.0
47	Shahpura	660.5	147.5	808.0
48	Todaraisingh	422.0	180.0	602.0
49	Tonk	870.0	141.0	1,011.0
50	Vallabh Nagar	939.0	116.0	1,055.0

PLATE - II



LEGEND

Admin Boundary:
- State Capital
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary

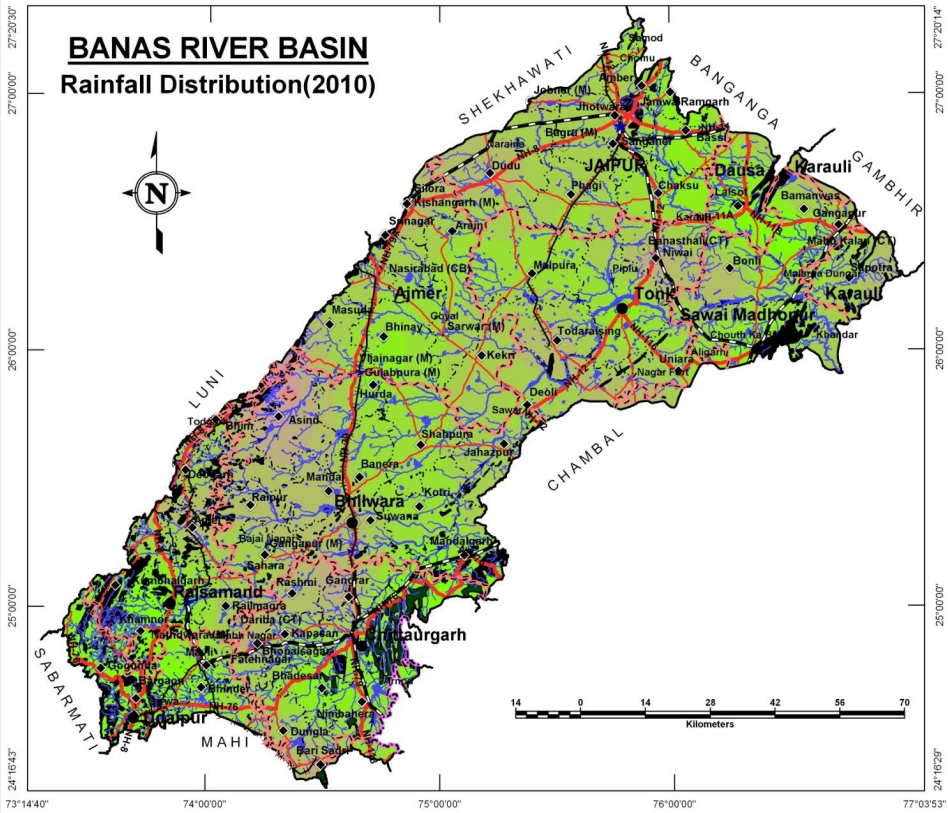
River Basin Boundary

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Elevation(m amsl):
1291 m
1000 m
750 m
500 m
176 m

Source : SRTM DEM

PLATE - III



LEGEND

Admin Boundary:
- State Capital
- District Headquarter
- Block Headquarter
- Town
- Raingauge Station
- State Boundary
- District Boundary
- Block Boundary

River Basin Boundary

Roads:
- National Highway
- State Highway

Railway:
- Broad Gauge
- Metre Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

Reserve Forest

Isohyets(mm):
- 300-400
- 400-500
- 500-600
- 600-700
- 700-800
- 800-900
- 900-1000
- > 1000

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GEOLOGY

BANAS RIVER BASIN

Formations ranging in age from Archaean to Recent period are present in the Basin represented by Bhilwara, Aravali, Delhi and Vindhyan Super Group of rocks along with Deccan volcanics and Alluvium.

Age	Super-Group	Group/Formation	Rock Types
Sub-Recent to Recent	Alluvium	Alluvium and sand Dunes	Sand, silt and clay
Upper Cretaceous to Palaeocene	Deccan Trap	Malwa Complex	Trap, Basaltic lava flows
Upper Precambrian To Lower Cambrian	Vindhyan	Bhander Group	Sandstone, shale and Lime stone
		Rewa Group	Sandstone, and shale
		Kaimur Group	Sandstone, shale and Conglomerate
----------x----------x----------x---------- Unconformity ----------x----------x----------x----------			
		Semri Group	Limestone, shale, Sandstone, grit, basic Flows. Etc.
(Acid, basic and ultrabasic intrusives and extrusives)			
----------x----------x----------x---------- Unconformity ----------x----------x----------x----------			
Precambrian	Delhi	Kumbhalgarh/ Ajabgarh Group	Quartzite, calc-gneiss, Mica schist, marble
		Gogunda/ Alwar Group	Quartzite, calc-schist Hornblende schist and Calc-silicate rocks
(Granite, basic and ultrabasic intrusives)			
	Aravali	Debhari/ Devda/ Kankroli/ Jharol/ Nathdwara/ Rikhabdeo Group	Quartzite, mica schist, Phyllite, dolomite, Marble, conglomerate, Meta-volcanic, grey-Wacke, amphibolites, Etc.
(Granite and basic intrusives)			
----------x----------x----------x---------- Unconformity ----------x----------x----------x----------			
Archaean	Bhilwara	Mangalwar Complex/ Sarwar/ Hindoli/ Jahazpur/ PurBanera/ Ranthambor/ RajpurDariba/ Berach Group	Phyllites, slates schists, Gneiss, granites, marble Quartzite, migmatite, Etc.
		Banded Gneissic Complex	Granites, gneisses, Schist's with migmatites

GEOMORPHOLOGY

Origin	Landform Unit	Description
Aeolian	Eolian Plain	Formed by aeolian activity, with sand dunes of varying height, size, slope. Long stretches of sand sheet. Gently sloping flat to undulating plain, comprised of fine to medium grained sand and silt. Also scattered xerophytic vegetation.
	Sandy Plain	Formed of aeolian activity, wind-blown sand with gentle sloping to undulating plain, comprising of coarse sand, fine sand, silt and clay.
Denudational	Buried Pediment	Pediment covers essentially with relatively thicker alluvial, colluvial or weathered materials.
	Dissected Plateau	Plateau, criss-crossed by fractures forming deep valleys.
	Intermontane Valley	Depression between mountains, generally broad & linear, filled with colluvial deposits.
	Pediment	Broad gently sloping rock flooring, erosional surface of low relief between hill and plain, comprised of varied lithology, criss-crossed by fractures and faults.
Fluvial	Alluvial Plain	Mainly undulating landscape formed due to fluvial activity, comprising of gravels, sand, silt and clay. Terrain mainly undulating, produced by extensive deposition of alluvium.
	Alluvial Plain (Sandy)	Flat to gentle undulating plain formed due to fluvial activity, mainly consists of gravels, sand, silt and clay with unconsolidated material of varying lithology, predominantly sand along river.
	Flood Plain	The surface or strip of relatively smooth land adjacent to a river channel formed by river and covered with water when river over flows its bank. Normally subject to periodic flooding.
	Paleochannel	Mainly buried on abandoned stream/river courses, comprising of coarse textured material of variable sizes.
	Valley Fill	Formed by fluvial activity, usually at lower topographic locations, comprising of boulders, cobbles, pebbles, gravels, sand, silt and clay. The unit has consolidated sediment deposits.
	Ravine	Small, narrow, deep, depression, smaller than gorges, larger than gulley, usually carved by running water.
	Water logged/ Wetland	Area submerged in water or area having very shallow water table. So that it submerges in water during rainy season.
Structural	Plateau	Formed over varying lithology with extensive, flat, landscapes, bordered by escarpment on all sides. Essentially formed horizontally layered rocky marked by extensive flat top and steep slopes. It may be criss crossed by lineament.
Hills	Denudational Hill	Steep sided, relict hills undergone denudation, comprising of varying lithology with joints, fractures and lineaments.
	Linear Ridge	Long narrow low-lying ridge usually barren, having high run off may form over varying lithology with controlled strike
	Structural Hill	Linear to arcuate hills showing definite trend-lines with varying lithology associated with folding, faulting etc.

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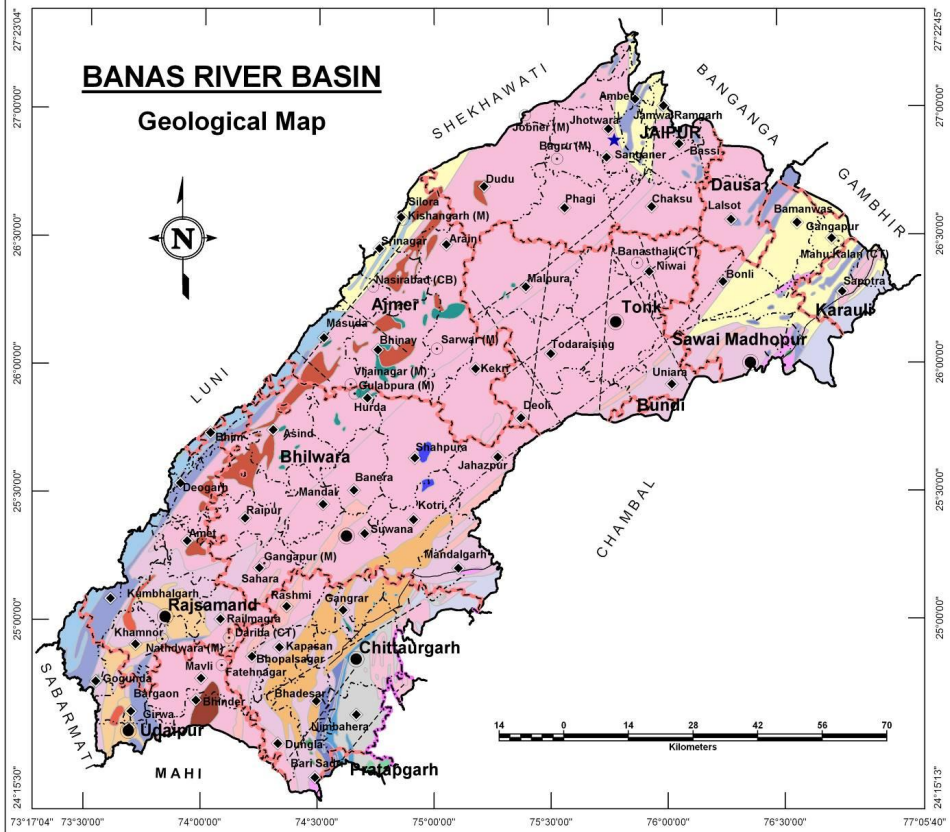
PLATE - IV

BANAS RIVER BASIN

Geological Map



LEGEND

Admin Boundary:

- State Capital
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- River Basin Boundary
- Water Bodies

Structural Features:

- Fault
- Great Boundary Fault
- Lineament
- Shear
- Thrust

Geology:

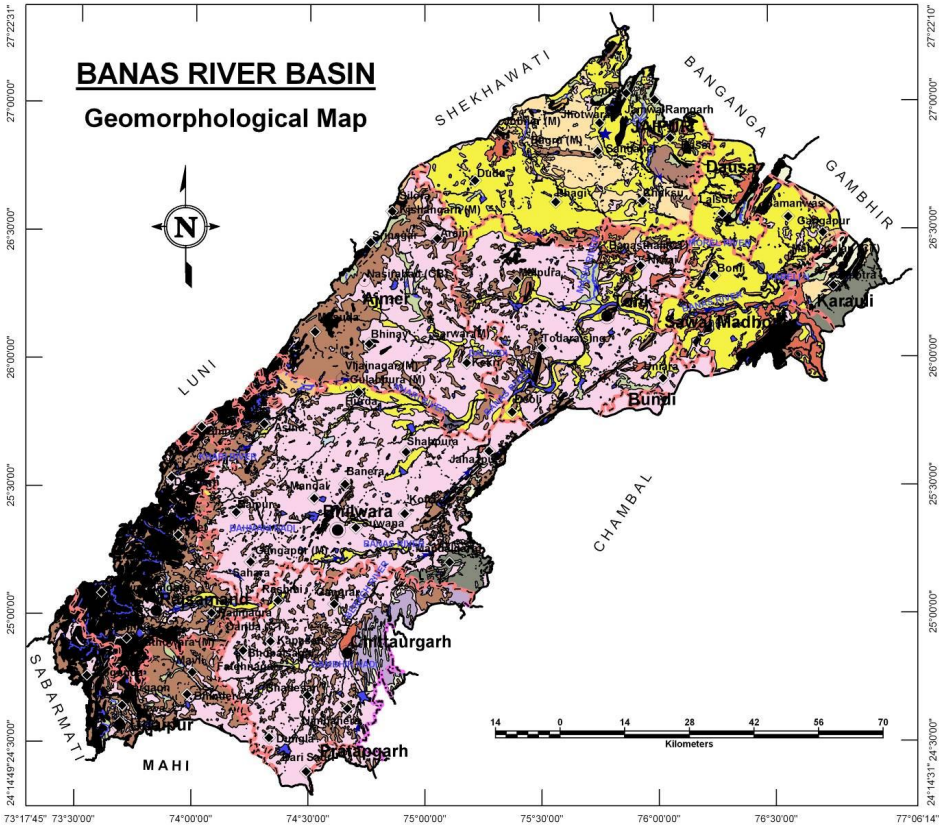
- Alluvium and Wind blown sand
- Kumbhalgarh Group
- Ajabgarh Group
- Gogunda Group
- Alwar Group
- Jharol Group
- Dovda Group
- Nathdwara Group
- Barilake Group
- Udaipur Group
- Kankroli Group
- Ranthambhor Group
- Jahazpur Group
- Pur-Banera Group
- Rajpura-Dariba Group
- Sawar Group
- Hindoli Group
- Mangalwar Complex
- Sand Mata Complex
- Bhander Group
- Rewa Group
- Kaimur Group
- Khorip Group
- Lasrawan Group
- Sand Group
- Satola Group
- Deccan Traps
- Sendra-Ambaji Granite & Gneiss
- Phulad Ophiolite Suite
- Kishangarh Syenite
- Undifferentiated granites
- Rakhabdev Ultramafic Suite
- Dolerite sills & dykes
- Udaipur/Salumbar/Udaisagar/Darwal Granite
- Berach Granite & Gneiss (2505 m.y.)
- Acidic Rocks
- Mafic Rocks
- Ultramafic rocks
- Untala & Gingla Granites (2960 m.y.)

Source : District Resource Map of Rajasthan - GSI

PLATE - V

BANAS RIVER BASIN

Geomorphological Map



LEGEND

Admin Boundary:

- State Capital
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- River Basin Boundary

Water Bodies:

- River/Ponds / Reservoirs

Structural Features:

- Fault/Fractures/Lineament

Hills:

- Structural/Denudational/Linear Ridge

Landforms Units:

Fluvial Origin:

- Alluvial plain
- Palaeochannel
- Alluvial Plain (Sandy)
- Ravine
- Flood Plain
- Valley Fill
- Waterlogged Area

Denudational Origin:

- Burried Pediment
- Pediment
- Intermontane Valley
- Dissected Plateau

Aeolian Origin:

- Sandy Plain
- Eolian Plain

Structural Origin:

- Plateau

Source : Ground Water Atlas of Rajasthan - SRSAC & GWD, Rajasthan

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AQUIFERS

BANAS RIVER BASIN

Aquifers in Banas river basin are largely formed in hard rock areas wherein Gneisses and Schists together constitute more 64% of the total basin area. Alluvial aquifers also occupy significant areas amounting to approximately 20% of the basin occurring mainly in the northern part of the in Jaipur, Dausa and Barauli districts.

Aquifer in Potential Zone	Area (Sq.Km)	% of Basin Area	Description of the unit/Occurrence
Younger Alluvium	1,864.0	4.0	It is largely constituted of Aeolian and Fluvial sand, silt, clay, gravel and pebbles in varying proportions.
Older Alluvium	7,529.0	16.1	This litho unit comprises of mixture of heterogeneous fine to medium grained sand, silt and kankar.
Limestone	730.8	1.6	In general, it is fine to medium grained, grey, red yellowish, pink or buff in colour.
Sandstone	656.0	1.4	Fine to medium grained, red colour and compact and at places.
Phyllite	1,846.8	3.9	These include meta sediments and represented by carbonaceous phyllite.
Schist	12,933.4	27.5	Medium to fine grained compact rock. The litho units are soft, friable and have closely spaced cleavage.
Shale	1,285.3	2.7	Grey, light green and purple in colour and mostly splintery in nature.
Basalt	57.9	0.1	Dark grey, olive green and green colour, compact, vesicular, amygdaloidal and weathered.
Quartzite	393.7	0.8	Medium to coarse grained and varies from feldspathic grit to sericitic quartzite.
Gneiss	12,795.7	27.2	Comprises of porphyritic and non porphyritic gneissic complex.
BGC	4,459.0	9.5	Grey to dark coloured, medium to coarse grained rocks.
Non Potential Zone (Hills , Reserve Forest)	2,447.7	5.2	Hills and reserve forests
Total	**46,999.3**	**100.0**	

LOCATION OF GROUND WATER MONITORING WELLS

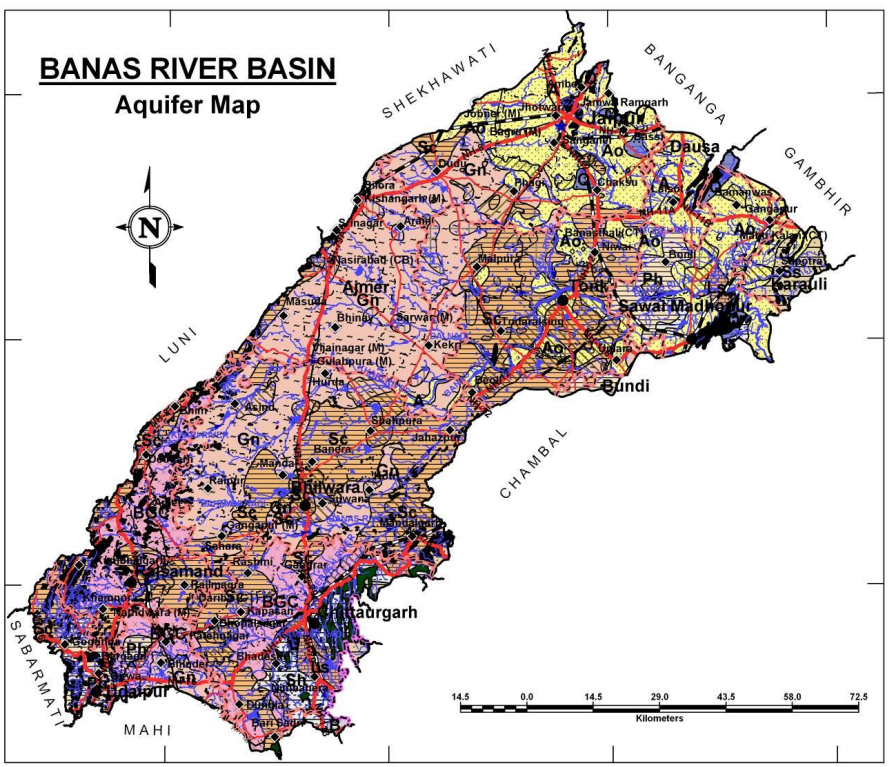
The basin has a well distributed network of large number of ground water monitoring stations (1,659) in the basin owned by RGWD (1,430) and CGWB (229). 364 additional wells have been recommended to be added to network to effectively monitor ground water quality and 8 additional wells for water level monitoring in the basin.

District Name	Existing Ground Water Monitoring Stations			Recommended Additional Ground Water Monitoring Stations	
	CGWB	RGWD	Total	Water Level	Water quality
Ajmer	18	213	231	-	1
Bhilwara	43	293	336	-	2
Bundi	-	12	12	-	-
Chittorgarh	13	194	207	-	43
Dausa	13	28	41	-	37
Jaipur	52	101	153	2	90
Karauli	6	10	16	5	19
Pratapgarh	-	9	9	-	2
Rajsamand	27	218	245	-	9
Sawai Madhopur	17	56	73	-	92
Tonk	20	167	187	-	56
Udaipur	20	129	149	1	13
Grand Total	**229**	**1,430**	**1,659**	**8**	**364**

PLATE - VI

BANAS RIVER BASIN

Aquifer Map



LEGEND

Admin Boundary:
- State Capital
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- River Basin Boundary

Roads:
- National Highway
- State Highway

Railway:
- Broad gauge
- Metre Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs
- Hills
- Reserve Forest
- Chemically Unsutiable Area
- Command Area
- Non Potential Zone
- Saline Area

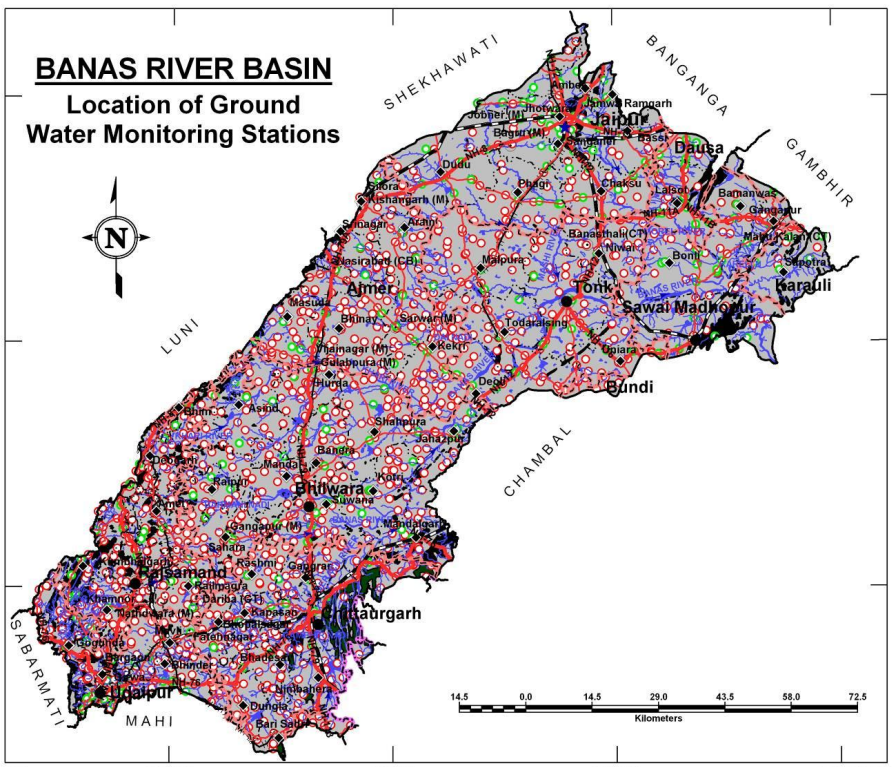
Aquifer:
- Younger Alluvium
- Older Alluvium
- Limestone
- Sandstone
- Phyllite
- Schist
- Shale
- Basalt
- Quartzite
- Gneiss
- BGC

Source: Ground Water Potential Zone Map - GWD,Rajasthan

PLATE - VII

BANAS RIVER BASIN

Location of Ground Water Monitoring Stations



LEGEND

Admin Boundary:
- State Capital
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- River Basin Boundary

Roads:
- National Highway
- State Highway

Railway:
- Broad gauge
- Metre Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs
- Hills
- Reserve Forest

Ground Water Monitoring Stations:
- CGWB
- RGWD

LOCATION OF EXPLORATORY WELLS

BANAS RIVER BASIN

In all there are 627 exploratory wells present in the basin drilled in the past by RGWD (438) and CGWB (189) that form good basis for delineation of sub-surface aquifer distribution.

District	Exploratory Wells		
	CGWB	RGWD	Total
Ajmer	5	48	53
Bhilwara	13	69	82
Bundi	1	3	4
Chittorgarh	3	25	28
Dausa	5	12	17
Jaipur	62	34	96
Karauli	4	6	10
Pratapgarh	-	-	-
Rajsamand	19	72	91
Sawai Madhopur	39	34	73
Tonk	17	94	111
Udaipur	21	41	62
Total	**189**	**438**	**627**

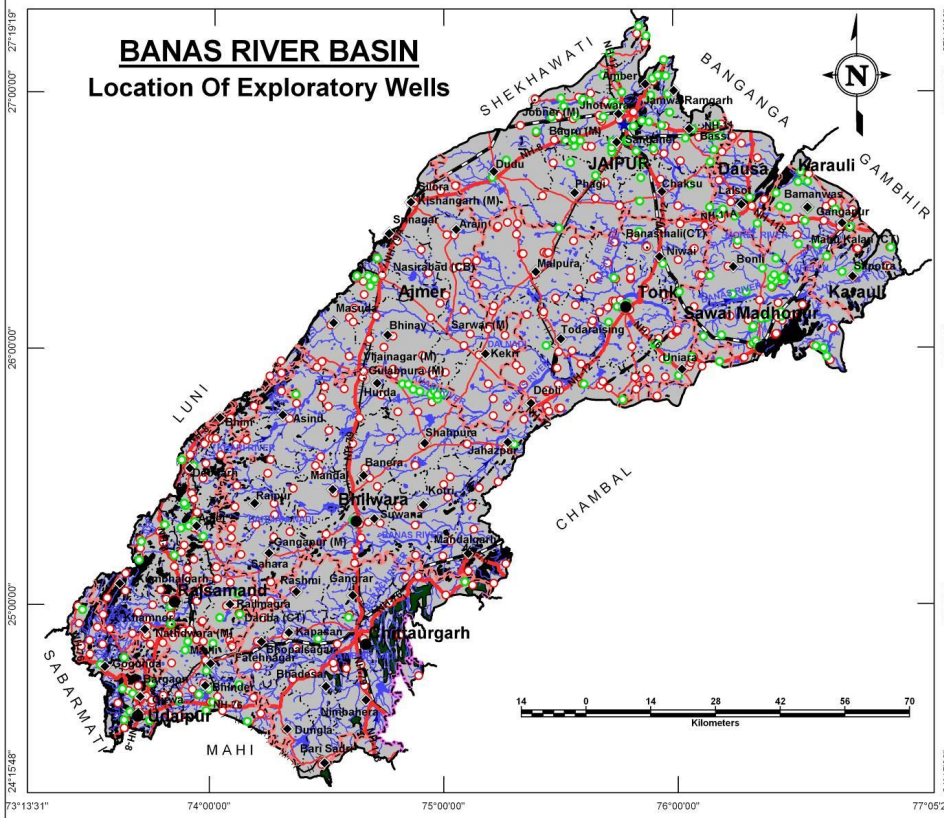
DEPTH TO WATER LEVEL (PRE MONSOON – 2010)

The general depth to water level in the basin ranges from 10 to 40 meters below ground level, as seen most part of the basin. In Jaipur district however, the water level occurs at quite deeper levels reaching upto 70m bgl and this cone of depression appears to spread towards east to areas around Dausa. Areas around Sawai Madhopur also have deeper water levels in the range of 30 to 50m bgl.

Depth to water level (m bgl) Pre Monsoon - 2010	District wise area coverage (sq km)*												Total Area (sq km)
	Ajmer	Bhilwara	Bundi	Chittorgarh	Dausa	Jaipur	Karauli	Pratapgarh	Rajsamand	Sawai Madhopur	Tonk	Udaipur	
< 10	367.2	325.8	-	14.8	-	15.2	22.4	-	12.1	174.1	168.4	68.2	**1,168.2**
10 - 20	4,230.0	7,014.3	149.2	3,061.0	138.4	2,104.5	543.6	168.2	2,998.3	1,894.9	5,676.2	1,688.9	**29,667.5**
20 - 30	826.2	1,585.0	16.3	1,778.5	549.4	1,403.0	475.5	6.2	615.2	1,255.7	849.9	551.4	**9,912.3**
30 - 40	31.8	73.5	-	101.5	331.7	1,380.2	0.1	-	10.8	168.0	10.6	36.8	**2,145.0**
40 - 50	-	7.9	-	1.9	82.2	986.0	-	-	-	71.5	-	0.4	**1,149.9**
50 - 60	-	-	-	-	0.5	416.4	-	-	-	15.9	-	-	**432.8**
60 - 70	-	-	-	-	-	63.7	-	-	-	-	-	-	**63.7**
> 70	-	-	-	-	-	12.7	-	-	-	-	-	-	**12.7**
Total	**5,455.2**	**9,006.5**	**165.5**	**4,957.7**	**1,102.2**	**6,381.7**	**1,041.6**	**174.4**	**3,636.4**	**3,580.1**	**6,705.1**	**2,345.7**	**44,552.1**

* The area covered in the derived maps is less than the total basin area since the hills have been excluded from interpolation/contouring.

PLATE - VIII



LEGEND

Admin Boundary:
- State Capital
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary

River Basin Boundary

Roads:
- National Highway
- State Highway

Railway:
- Broad Gauge
- Metre Gauge

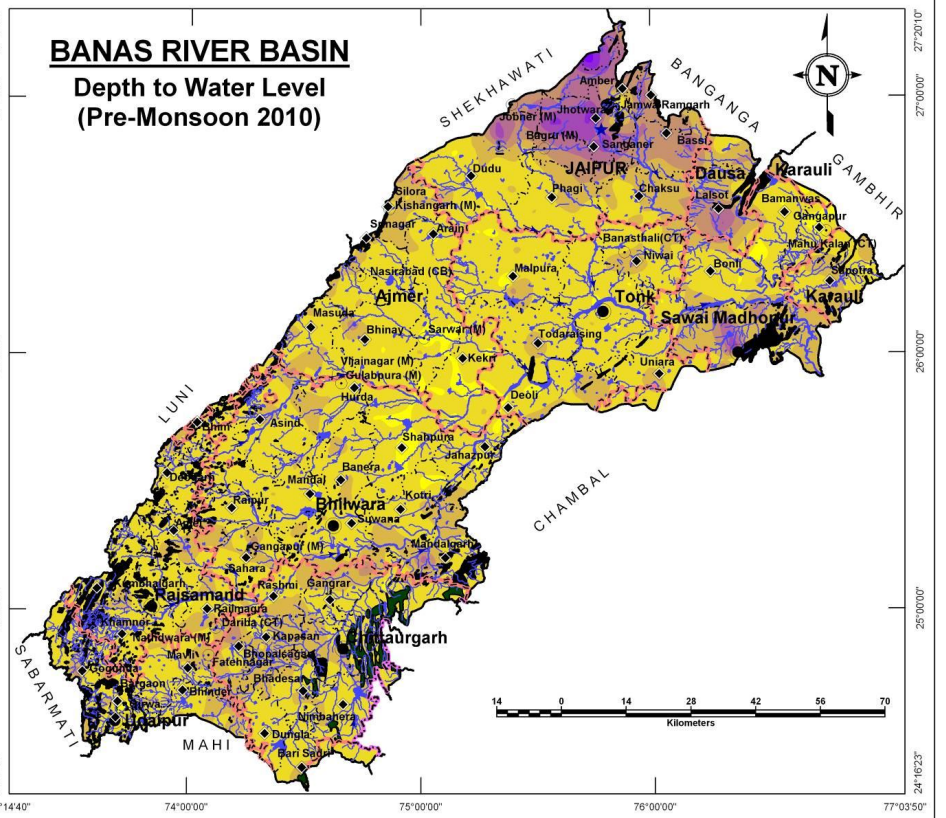
Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

Reserve Forest

Exploratory Wells:
- CGWB
- RGWD

PLATE - IX



LEGEND

Admin Boundary:
- State Capital
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary

River Basin Boundary

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

Reserve Forest

Depth to Water Level(m bgl):
- < 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- 50 - 60
- 60 - 70
- > 70

WATER TABLE ELEVATION (PRE MONSOON 2010)

BANAS RIVER BASIN

Water table elevation is important to understand ground water flow direction. On studying the Plate –X, it is revealed that the ground water flows from southwestern part adjoining hills, towards northeast and finally to east in Sawai Madhopur area.

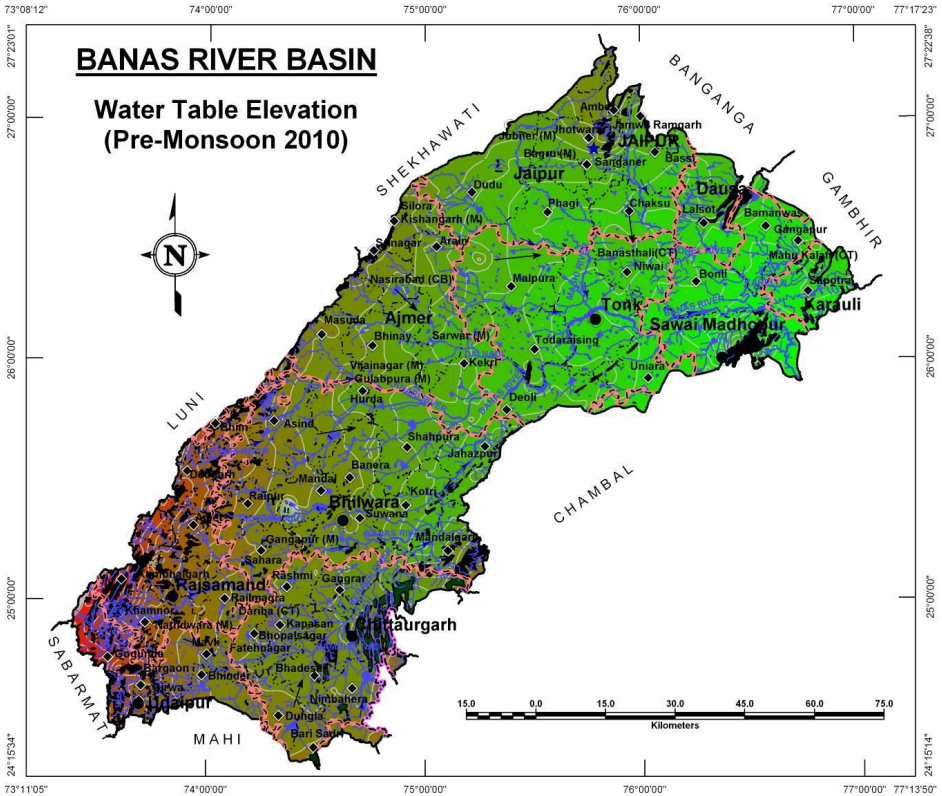
Water Table Elevation (m amsl) Pre Monsoon - 2010	District wise area coverage (sq km)												Total Area (sq km)
	Ajmer	Bhilwara	Bundi	Chittorgarh	Dausa	Jaipur	Karauli	Pratapgarh	Rajsamand	Sawai Madhopur	Tonk	Udaipur	
< 200	-	-	-	-	-	-	-	-	-	4.4	-	-	**4.4**
200 - 220	-	-	-	-	-	-	91.4	-	-	579.6	-	-	**671.0**
220 - 240	-	-	-	-	-	-	394.7	-	-	953.7	-	-	**1,348.4**
240 - 260	-	0.4	125.5	-	230.1	-	266.4	-	-	1,585.9	603.2	-	**2,811.5**
260 - 280	-	0.9	31.1	-	225.4	154.0	264.6	-	-	402.7	1,763.4	-	**2,842.1**
280 - 300	-	3.0	8.9	-	278.7	1,044.9	24.5	-	-	47.2	1,691.7	-	**3,098.9**
300 - 320	336.9	194.7	-	-	368.0	1,421.0	-	-	-	6.6	1,689.1	-	**4,016.3**
320 - 340	693.1	966.0	-	-	-	1,186.2	-	-	-	-	686.6	-	**3,531.9**
340 - 360	783.9	1,169.2	-	13.4	-	947.1	-	-	-	-	241.6	-	**3,155.2**
360 - 380	1,006.0	1,215.7	-	233.8	-	788.8	-	-	-	-	28.1	-	**3,272.4**
380 - 400	941.6	1,129.8	-	645.1	-	370.8	-	-	-	-	1.4	-	**3,088.7**
400 - 440	1,323.6	1,731.8	-	2,538.2	-	468.9	-	-	0.3	-	-	-	**6,062.8**
440 - 480	319.0	1,398.6	-	1,390.4	-	-	-	136.1	395.5	-	-	624.1	**4,263.7**
480 - 520	7.8	811.4	-	134.3	-	-	-	38.3	522.2	-	-	481.7	**1,995.7**
520 - 560	6.9	366.6	-	2.5	-	-	-	-	711.6	-	-	303.0	**1,390.6**
560 - 600	5.3	18.4	-	-	-	-	-	-	742.0	-	-	167.0	**932.7**
600 - 640	13.0	-	-	-	-	-	-	-	566.9	-	-	133.3	**713.2**
640 - 680	18.1	-	-	-	-	-	-	-	284.2	-	-	124.9	**427.2**
680 - 720	-	-	-	-	-	-	-	-	187.6	-	-	113.8	**301.4**
720 - 760	-	-	-	-	-	-	-	-	97.8	-	-	100.6	**198.4**
760 - 800	-	-	-	-	-	-	-	-	44.0	-	-	111.4	**155.4**
800 - 840	-	-	-	-	-	-	-	-	28.6	-	-	141.2	**169.8**
840 - 880	-	-	-	-	-	-	-	-	23.6	-	-	30.1	**53.7**
880 - 920	-	-	-	-	-	-	-	-	30.9	-	-	12.6	**43.5**
> 920	-	-	-	-	-	-	-	-	1.2	-	-	2.0	**3.2**
Total	**5,455.2**	**9,006.5**	**165.5**	**4,957.7**	**1,102.2**	**6,381.7**	**1,041.6**	**174.4**	**3,636.4**	**3,580.1**	**6,705.1**	**2,345.7**	**44,552.1**

WATER LEVEL FLUCTUATION (PRE TO POST MONSOON 2010)

Gneisses and Schists are in the basin form predominant aquifers and water level fluctuation is significant in in these areas. Sawai Madhopur, east of Bhilwara, Phagi and Kishangarh, Most parts of Rajsamand and Udaipur districts and eastern parts of Chittaurgarh show variation of water level between pre and post monsoon in the range of more than 8m. Alluvial aquifers in Jaipur and Dausa show negative fluctuation indicating towards permanent depletion of ground water resource.

District Name	District wise area coverage (sq km) within fluctuation range (m)													Total Area (sq km)
	< -4	-4 to -2	-2 to 0	0 to 2	2 to 4	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14 to 16	16 to 18	> 18	
Ajmer	3.5	16.7	48.4	308.1	977.2	1,465.3	1,407.4	738.7	295.3	122.8	43.6	22.0	6.3	**5,455.3**
Bhilwara	3.7	16.8	47.9	239.2	1,204.7	1,792.2	2,028.8	1,712.7	1,048.8	556.3	199.4	92.3	63.5	**9,006.3**
Bundi	-	-	-	-	10.4	29.6	30.5	84.2	10.8	-	-	-	-	**165.5**
Chittorgarh	-	-	13.8	281.9	790.3	1,106.3	1,139.1	860.5	552.5	186.9	24.5	1.9	-	**4,957.7**
Dausa	-	20.1	138.5	555.5	275.9	81.4	25.1	5.8	-	-	-	-	-	**1,102.3**
Jaipur	-	39.7	692.3	1,548.2	1,210.2	1,030.8	680.9	639.0	360.5	102.7	57.0	16.9	3.4	**6,381.6**
Karauli	-	-	-	315.3	467.5	116.6	58.8	31.4	20.9	14.3	9.6	6.4	0.7	**1,041.5**
Pratapgarh	-	-	-	17.7	44.6	56.7	55.3	-	-	-	-	-	-	**174.3**
Rajsamand	-	-	-	20.7	104.6	363.6	683.9	1,185.3	858.0	336.8	78.6	4.8	-	**3,636.3**
Sawai Madhopur	-	-	1.9	657.0	1,644.5	473.1	290.4	305.2	132.6	43.0	21.1	9.7	1.7	**3,580.2**
Tonk	-	-	62.0	256.7	1,275.4	1,863.9	1,609.5	913.6	544.2	145.6	31.6	2.6	-	**6,705.1**
Udaipur	-	-	3.1	63.1	87.1	200.1	513.6	616.4	541.6	250.8	61.4	7.2	0.7	**2,345.1**
Total	**7.2**	**93.3**	**1,007.9**	**4,263.4**	**8,092.4**	**8,579.6**	**8,523.3**	**7,092.8**	**4,365.2**	**1,759.2**	**526.8**	**163.8**	**76.3**	**44,551.2**

PLATE - X



LEGEND

Admin Boundary:
- State Capital
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary

River Basin Boundary

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Reserve Forest

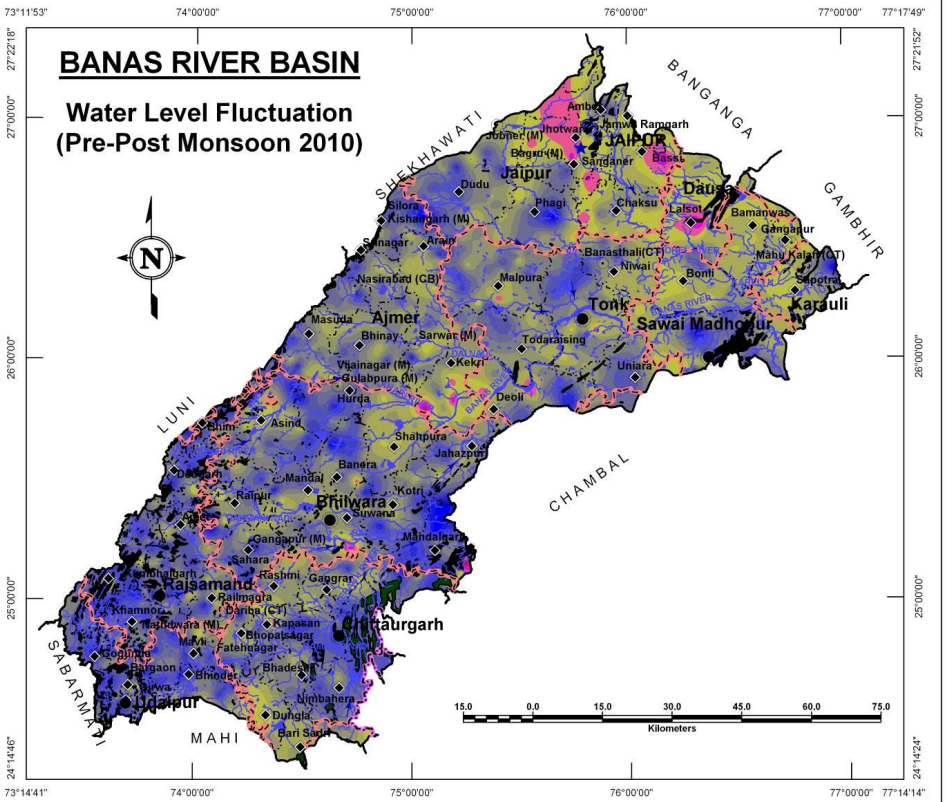
Hills

Water Table Elevation

Water Table Elevation(m amsl):

<200	480 - 520
200 - 220	520 - 560
220 - 240	560 - 600
240 - 260	600 - 640
260 - 280	640 - 680
280 - 300	680 - 720
300 - 320	720 - 760
320 - 340	760 - 800
340 - 360	800 - 840
360 - 380	840 - 880
380 - 400	880 - 920
400 - 440	> 920
440 - 480	

PLATE - XI



LEGEND

Admin Boundary:
- State Capital
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary

River Basin Boundary

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Reserve Forest

Hills

Water Level Fluctuation(m):
- < -4
- -4 to -2
- -2 to 0
- 0 to 2
- 2 to 4
- 4 to 6
- 6 to 8
- 8 to 10
- 10 to 12
- 12 to 14
- 14 to 16
- 16 to 18
- > 18

ELECTRICAL CONDUCTIVITY DISTRIBUTION

BANAS RIVER BASIN

The Electrical Conductivity (at 25°C) map is presented in Plate - XII. The electrical conductivity values <2000 µS/cm are observed in the eastern, western and northern part of the basin especially around hilly areas. Significant area in the basin is shows EC value ranging of >2000 µS/cm. High EC value is observed as pockets spread all over the area in central part and western part of the basin and also in the southern part. High salinity area in the Bhilwara-Shahpura-Kekri-Nasirabad-Arain-Dudu region is noteworthy.

Electrical Conductivity Ranges (µS/cm at 25°C) (Ave. of years 2005-09)	District wise area coverage (sq km)																						Total Area (sq km)
	Ajmer		Bhilwara		Bundi		Chittorgarh		Dausa		Jaipur		Karauli		Pratapgarh		Rajsamand		Sawai Madhopur		Tonk		Udaipur		
	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	
< 2000	1,404.2	25.7	5,098.8	56.6	164.9	99.6	4,146.4	83.6	845.3	76.7	3,220.7	50.5	966.0	92.8	174.3	100.0	2,299.3	63.2	2,916.1	81.5	4,102.3	61.2	1,460.2	62.3	**26,798.7**
2000-4000	2,497.8	45.8	3,429.0	38.1	0.6	0.4	744.0	15.0	176.7	16.0	2,697.4	42.3	68.6	6.6	-	0.0	1,239.7	34.1	506.1	14.1	2,379.5	35.5	729.7	31.1	**14,469.3**
> 4000	1,553.2	28.5	478.5	5.3	-	0.0	67.3	1.4	80.1	7.3	463.6	7.3	6.9	0.7	-	0.0	97.3	2.7	157.9	4.4	223.3	3.3	155.1	6.6	**3,284.1**
Total Area	**5,455.3**	**100.0**	**9,006.4**	**100.0**	**165.6**	**100.0**	**4,957.7**	**100.0**	**1,102.1**	**100.0**	**6,381.6**	**100.0**	**1,041.6**	**100.0**	**174.3**	**100.0**	**3,636.3**	**100.0**	**3,580.2**	**100.0**	**6,705.1**	**100.0**	**2,345.0**	**100.0**	**44,552.1**

CHLORIDE DISTRIBUTION

High chloride concentration in ground water also renders it unsuitable for domestic and other purposes. The red coloured regions in Plate – XIII are such areas where Chloride concentration is very high (> 1000 mg/l) which are largely found in hard rock aquifers in central and northwestern part of the basin as pockets. The basin however shows overall a high chloride concentration in ground water since if the areas of 250 -1000 mg/l and > 1000 mg/l are combined, they together occupy significant parts of the area of the basin. Good quality water with low Chloride concentration (<250 mg/l) are very limited in spatial distribution and found in the close proximity of hilly areas.

Chloride Ranges (mg/l) (Ave. of years 2005-09)	District wise area coverage (sq km)																						Total Area (sq km)
	Ajmer		Bhilwara		Bundi		Chittorgarh		Dausa		Jaipur		Karauli		Pratapgarh		Rajsamand		Sawai Madhopur		Tonk		Udaipur		
	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	
< 250	763.6	14.0	3,221.9	35.8	143.0	86.4	3,603.2	72.6	726.2	65.9	2,394.9	37.5	964.9	92.6	174.4	100.0	1,376.6	37.9	2,565.3	71.7	2,924.1	43.6	1,051.8	44.8	**19,909.9**
250 - 1000	3,382.8	62.0	5,440.8	60.4	22.5	13.6	1,337.1	27.0	296.7	26.9	3,628.0	56.9	76.7	7.4	-	-	2,219.8	61.0	949.1	26.5	3,656.7	54.5	1,227.6	52.4	**22,237.8**
> 1000	1,308.8	24.0	343.8	3.8	-	-	17.4	0.4	79.3	7.2	358.8	5.6	-	-	-	-	40.0	1.1	65.7	1.8	124.3	1.9	66.3	2.8	**2,404.4**
Total	**5,455.2**	**100.0**	**9,006.5**	**100.0**	**165.5**	**100.0**	**4,957.7**	**100.0**	**1,102.2**	**100.0**	**6,381.7**	**100.0**	**1,041.6**	**100.0**	**174.4**	**100.0**	**3,636.4**	**100.0**	**3,580.1**	**100.0**	**6,705.1**	**100.0**	**2,345.7**	**100.0**	**44,552.1**

Ground Water Department,
Rajasthan

European Union
State Partnership Programme

PLATE - XII

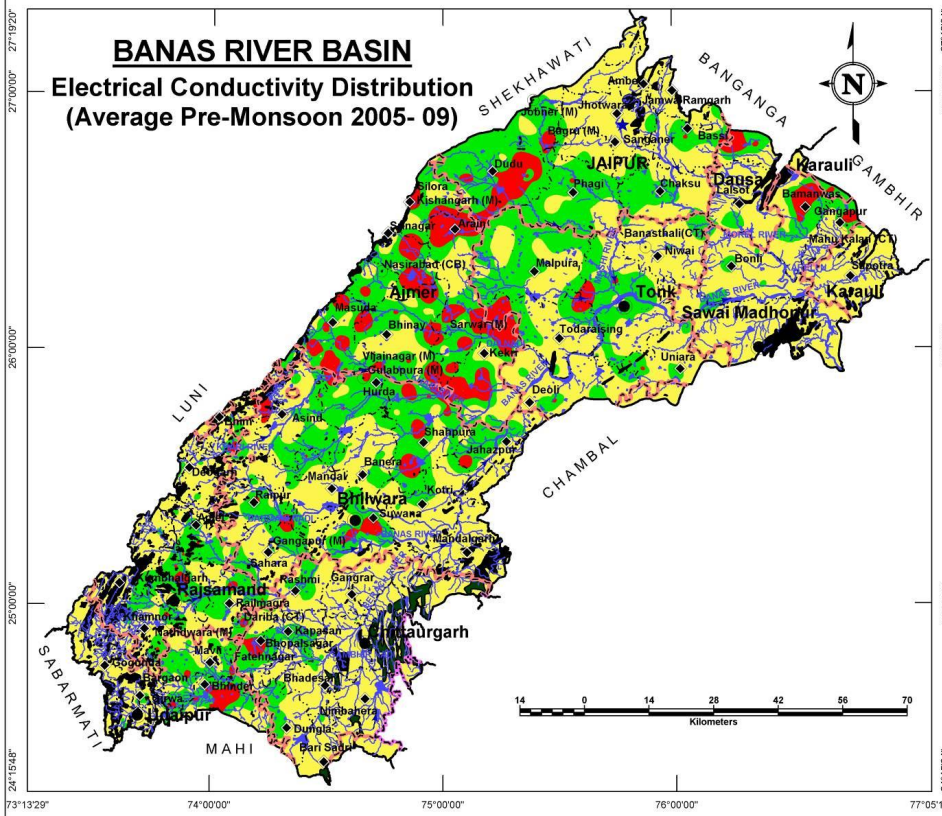
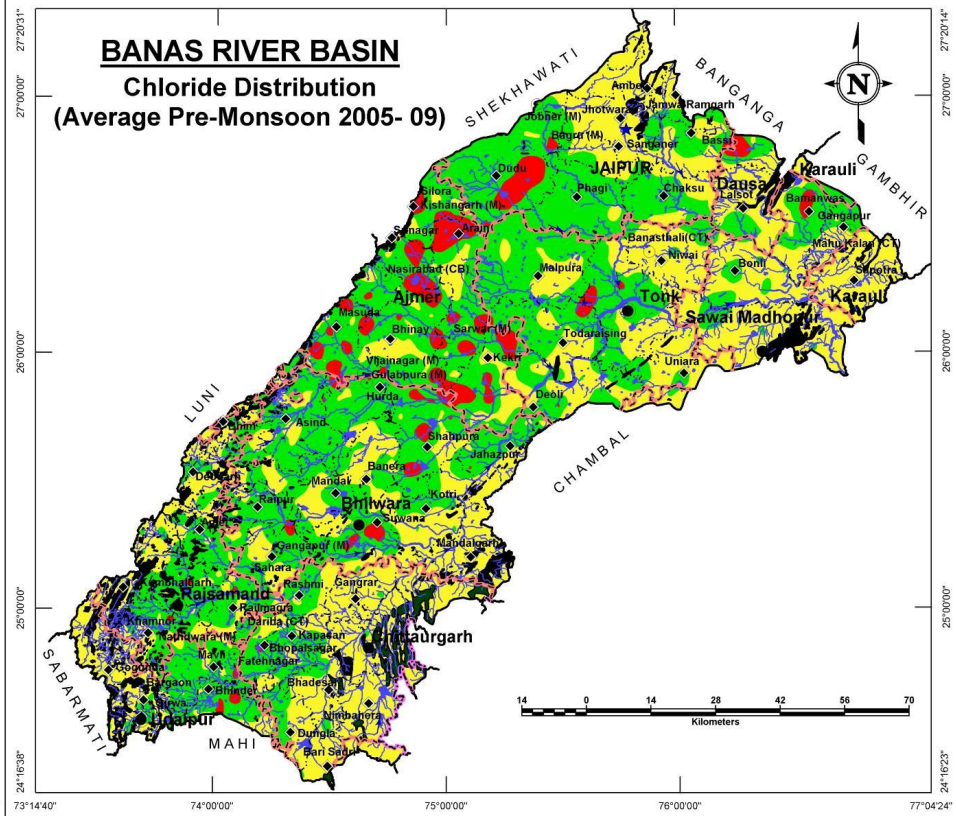


PLATE - XIII



LEGEND

Admin Boundary:

- State Capital
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **River Basin Boundary**

Water Bodies:

- River / Streams
- Ponds / Reservoirs
- **Hills**
- **Reserve Forest**

Electrical Conductivity (µS/cm at 25°C):

- < 2000
- 2000-4000
- > 4000

LEGEND

Admin Boundary:

- State Capital
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **River Basin Boundary**

Water Bodies:

- River / Streams
- Ponds / Reservoirs
- **Hills**
- **Reserve Forest**

Chloride Concentration (mg/l):

- < 250
- 250 - 1000
- > 1000

ROLTA
Rolta India Limited

FLUORIDE DISTRIBUTION

BANAS RIVER BASIN

The Fluoride concentration map (Plate – XIV) displays a number of scattered patches of high fluoride concentration (>3 mg/l) which is surrounded but an even larger area having 1.5 – 3.0 mg/l of fluoride in ground water. Together these two areas combined (i.e., > 1.5 mg/l), occupy more than 80% of the basin rendering the ground water of limited use from fluoride concentration point of view. Interestingly, the high moderate and concentration areas correspond well with the gneissic aquifers and adjacent schist aquifers in central and southern parts of the basin.

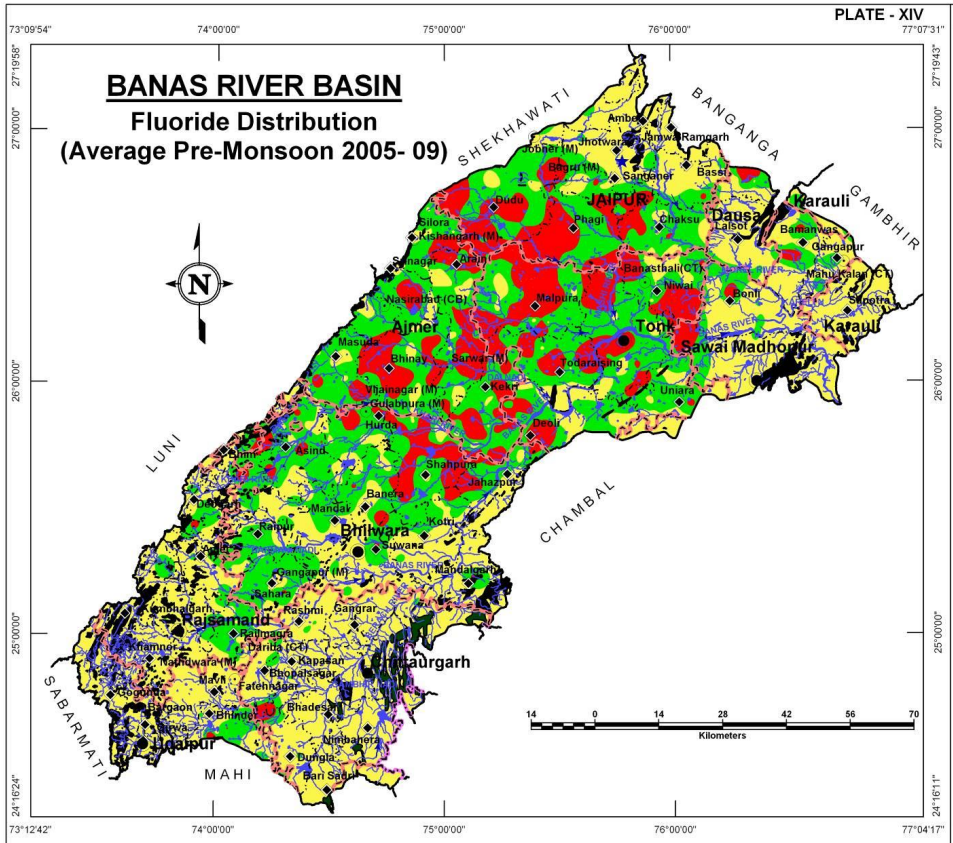
Fluoride Ranges (mg/l) (Ave. of years 2005-09)	District wise area coverage (sq km)																						Total Area (sq km)
	Ajmer		Bhilwara		Bundi		Chittorgarh		Dausa		Jaipur		Karauli		Pratapgarh		Rajsamand		Sawai Madhopur		Tonk		Udaipur		
	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	
< 1.5	568.6	10.4	3,801.5	42.2	165.5	100.0	4,725.3	95.3	853.1	77.4	2,293.1	35.9	1,002.3	96.2	174.4	100.0	2,773.7	76.2	2,611.8	73.0	1,029.6	15.4	2,109.9	90.0	**22,108.8**
1.5-3.0	3,162.8	58.0	4,245.4	47.1	-	-	167.6	3.4	198.4	18.0	2,433.1	38.2	39.3	3.8	-	-	802.4	22.1	750.3	20.9	3,395.7	50.6	224.0	9.5	**15,419.0**
> 3.0	1,723.8	31.6	959.6	10.7	-	-	64.8	1.3	50.7	4.6	1,655.5	25.9	-	-	-	-	60.3	1.7	218.0	6.1	2,279.8	34.0	11.8	0.5	**7,024.3**
Total	**5,455.2**	**100.0**	**9,006.5**	**100.0**	**165.5**	**100.0**	**4,957.7**	**100.0**	**1,102.2**	**100.0**	**6,381.7**	**100.0**	**1,041.6**	**100.0**	**174.4**	**100.0**	**3,636.4**	**100.0**	**3,580.1**	**100.0**	**6,705.1**	**100.0**	**2,345.7**	**100.0**	**44,552.1**

NITRATE DISTRIBUTION

High nitrate concentration in ground water renders it unsuitable for agriculture purposes. Plate XV shows distribution of Nitrate in ground water. Approximately, 38% of the area shows low concentration levels of Nitrate in ground water (< 50 mg/l) followed by moderate concentration areas occupying 37% of the basin area and the rest (i.e., about 25%) has high concentration of Nitrate in ground water. The distribution is scattered and all over the basin however, the southern part has relatively more Nitrate as compared to rest of the basin.

Nitrate Ranges (mg/l) (Ave. of years 2005-09)	District wise area coverage (sq km)																						Total Area (sq km)
	Ajmer		Bhilwara		Bundi		Chittorgarh		Dausa		Jaipur		Karauli		Pratapgarh		Rajsamand		Sawai Madhopur		Tonk		Udaipur		
	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	Area	% age	
< 50	2,129.1	39.0	2,925.4	32.5	120.2	72.6	1,472.9	29.7	765.4	69.5	3,164.7	49.6	399.5	38.4	17.5	10.0	1,321.2	36.3	1,242.3	34.7	2,613.0	39.0	734.7	31.3	**16,905.9**
50-100	2,062.8	37.8	3,011.3	33.4	36.1	21.8	1,931.0	38.9	216.7	19.7	2,372.0	37.2	515.1	49.4	140.9	80.8	1,407.0	38.7	1,418.0	39.6	2,761.9	41.2	779.3	33.2	**16,652.1**
> 100	1,263.3	23.2	3,069.8	34.1	9.2	5.6	1,553.8	31.4	120.1	10.8	845.0	13.2	127.0	12.2	16.0	9.2	908.2	25.0	919.8	25.7	1,330.2	19.8	831.7	35.5	**10,994.1**
Total	**5,455.2**	**100.0**	**9,006.5**	**100.0**	**165.5**	**100.0**	**4,957.7**	**100.0**	**1,102.2**	**100.0**	**6,381.7**	**100.0**	**1,041.6**	**100.0**	**174.4**	**100.0**	**3,636.4**	**100.0**	**3,580.1**	**100.0**	**6,705.1**	**100.0**	**2,345.7**	**100.0**	**44,552.1**

PLATE - XIV



LEGEND

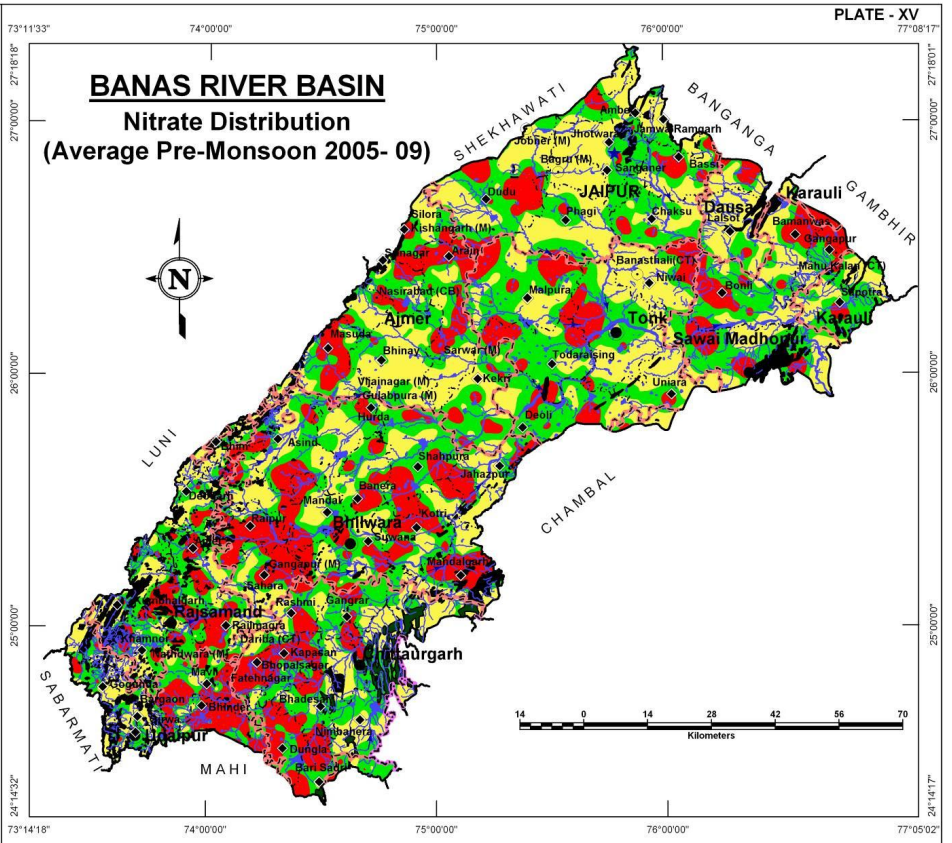
Admin Boundary:

- State Capital
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **River Basin Boundary**
- **Water Bodies:**
- River / Streams
- Ponds / Reservoirs
- **Hills**
- **Reserve Forest**

Fluoride Concentration (mg/l):

- < 1.5
- 1.5-3.0
- > 3.0

PLATE - XV



LEGEND

Admin Boundary:

- State Capital
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **River Basin Boundary**
- **Water Bodies:**
- River / Streams
- Ponds / Reservoirs
- **Hills**
- **Reserve Forest**

Nitrate Concentration (mg/l):

- < 50
- 50-100
- > 150

DEPTH TO BEDROCK

BANAS RIVER BASIN

A perusal of the Plate – XVI, showing distribution of depth to bedrock (in meters above ground level), it is apparent that the depth to bed rock is at deeper levels in northern part of the river basin which gradually shallow down in central part. The bedrock depth varies from more than 160 m bgl in the northern part to 0m bgl in other parts of the areas and to hilly areas. This map also helps in interpreting the thickness of alluvial and weathered/fractured hard rocks in the river basin.

Depth to Bedrock (m bgl)	District wise area coverage (sq km)												Total Area (sq km)
	Ajmer	Bhilwara	Bundi	Chittorgarh	Dausa	Jaipur	Karauli	Pratapgarh	Rajsamand	Sawai Madhopur	Tonk	Udaipur	
<20	3,422.7	821.4	57.7	582.4	-	229.4	-	120.0	452.5	440.9	2,603.3	413.8	**9,144.1**
20-40	1,966.1	5,649.8	90.6	3,138.3	256.4	2,130.9	547.3	54.1	1,777.3	2,326.5	3,810.0	976.0	**22,723.3**
40-60	53.1	2,178.3	13.4	1,189.2	777.3	2,319.9	455.8	0.3	1,143.4	781.6	284.5	775.0	**9,971.8**
60-80	13.2	203.3	3.8	16.2	68.5	1,245.9	38.5	-	168.2	31.1	7.3	149.7	**1,945.7**
80-100	0.1	63.3	-	16.7	-	446.3	-	-	71.1	-	-	25.4	**622.9**
100-120	-	37.4	-	6.4	-	9.3	-	-	18.9	-	-	5.8	**77.8**
120-140	-	21.5	-	1.4	-	-	-	-	4.2	-	-	-	**27.1**
140-160	-	11.8	-	2.8	-	-	-	-	0.8	-	-	-	**15.4**
160-180	-	10.3	-	3.6	-	-	-	-	-	-	-	-	**13.9**
>180	-	9.4	-	0.7	-	-	-	-	-	-	-	-	**10.1**
Total	**5,455.2**	**9,006.5**	**165.5**	**4,957.7**	**1,102.2**	**6,381.7**	**1,041.6**	**174.4**	**3,636.4**	**3,580.1**	**6,705.1**	**2,345.7**	**44,552.1**

UNCONFINED AQUIFER

The alluvial material is predominantly alluvial or fluvial origin sand, clay and gravel. The thickness of alluvial aquifer varies from very thin layers to about 40m reaching maximum around Jaipur, Dausa and Gangapur. The hardrock aquifers are formed in weathered and fractured part of the hard rocks that can retain water under unconfined conditions. Such aquifers are formed in Sandstone, Limestone, Shale, Dolomite, Phyllite, Schist, Quartzite, and Gneiss. These aquifers attain good thickness of 60-80m in southern parts of the basin (reaching to a maximum of about 100m) moderate to less deep in central parts in Bhilwara-Tonk-Jaipur-Ajmer region.

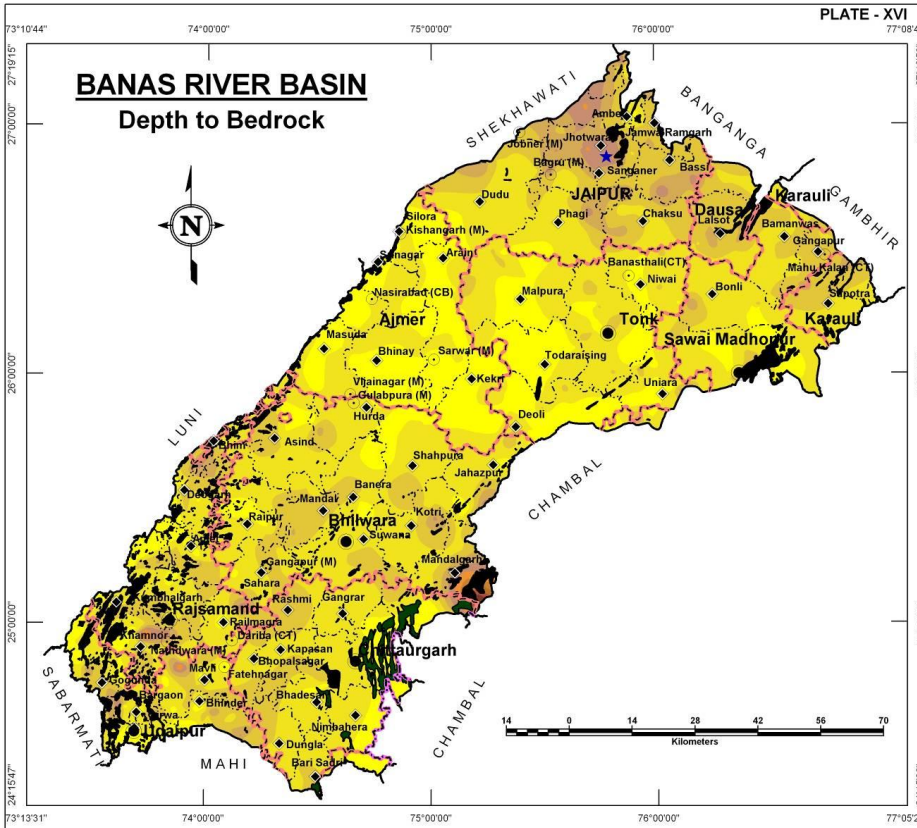
Alluvial areas:

Unconfined aquifer Thickness (m)	District area coverage (sq km)												Total Area (sq km)
	Ajmer	Bhilwara	Bundi	Chittorgarh	Dausa	Jaipur	Karauli	Pratapgarh	Rajsamand	Sawai Madhopur	Tonk	Udaipur	
<10	134.7	-	-	-	670.9	3,441.4	178.3	-	-	1,291.9	1,336.6	-	**7,053.8**
10-20	-	-	-	-	328.8	494.2	102.8	-	-	596.7	67.4	-	**1,589.9**
20-30	-	-	-	-	84.9	131.6	135.5	-	-	215.0	4.7	-	**571.7**
30-40	-	-	-	-	17.4	12.2	55.9	-	-	60.7	-	-	**146.2**
>40	-	-	-	-	-	-	8.7	-	-	2.1	-	-	**10.8**
Total	**134.7**	**-**	**-**	**-**	**1,102.0**	**4,079.4**	**481.2**	**-**	**-**	**2,166.4**	**1,408.7**	**-**	**9,372.4**

Hardrock areas:

Unconfined aquifer Thickness (m)	District area coverage(sq km)												Total Area (sq km)
	Ajmer	Bhilwara	Bundi	Chittorgarh	Dausa	Jaipur	Karauli	Pratapgarh	Rajsamand	Sawai Madhopur	Tonk	Udaipur	
<10	4,272.0	1,555.3	75.1	1,021.0	0.2	823.2	49.1	167.5	737.7	814.1	3,044.6	494.3	13,054.1
10-20	957.4	3,968.1	50.0	1,780.2	-	850.3	511.3	6.9	1,049.9	471.6	1,877.9	652.2	12,175.8
20-30	49.6	2,204.2	23.7	1,354.5	-	431.6	-	-	1,004.6	111.5	326.4	626.6	6,132.7
30-40	10.3	942.7	10.1	713.4	-	117.4	-	-	521.4	16.5	37.6	314.7	2,684.1
40-50	0.7	254.2	5.8	88.6	-	57.5	-	-	191.8	-	9.1	143.4	751.1
50-60	5.4	59.8	0.8	-	-	22.3	-	-	68.7	-	0.8	69.8	227.6
60-70	13.4	21.1	-	-	-	-	-	-	31.1	-	-	23.8	89.4
70-80	9.4	1.1	-	-	-	-	-	-	17.8	-	-	12.7	41.0
80-90	2.3	-	-	-	-	-	-	-	10.2	-	-	4.9	17.4
90-100	-	-	-	-	-	-	-	-	3.2	-	-	2.6	5.8
>100	-	-	-	-	-	-	-	-	-	-	-	0.7	0.7
Total	5,320.5	9,006.5	165.5	4,957.7	0.2	2,302.3	560.4	174.4	3,636.4	1,413.7	5,296.4	2,345.7	35,179.7

PLATE - XVI



LEGEND

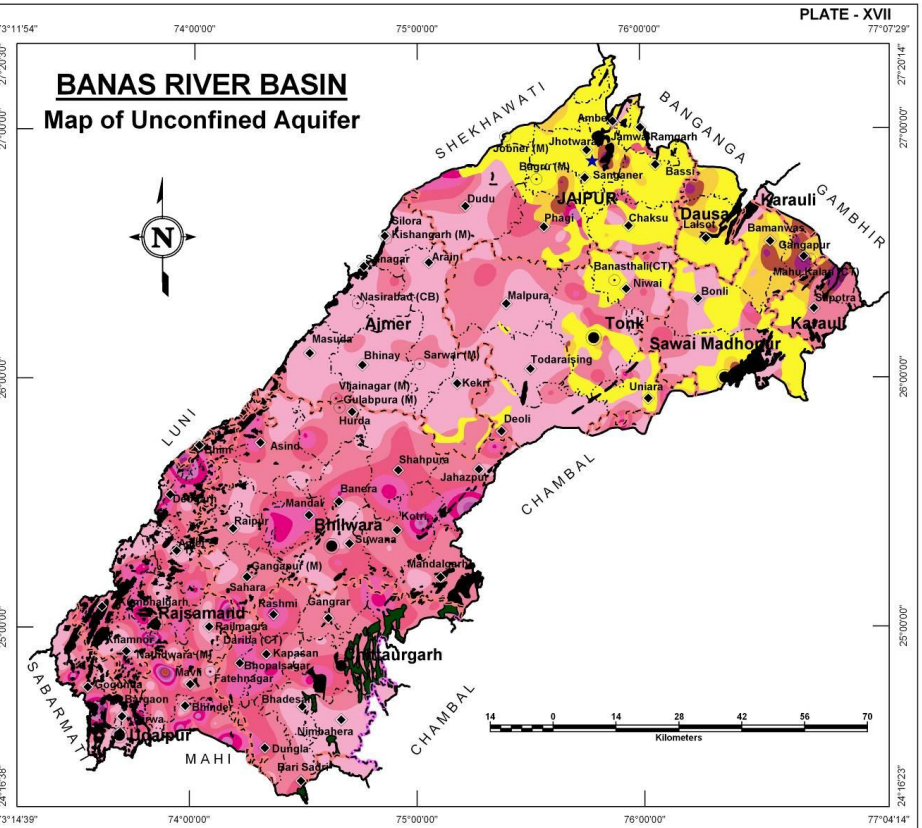
Admin Boundary:

- State Capital
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- River Basin Boundary
- Hills
- Reserve Forest

Depth to Bedrock(m bgl):

- < 20
- 20-40
- 40-60
- 60-80
- 80-100
- 100-120
- 120-140
- 140-160
- 160-180
- > 180

PLATE - XVII



LEGEND

Admin Boundary:

- State Capital
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- River Basin Boundary
- Hills
- Reserve Forest

Aquifer Thickness(m):

Alluvial Area:

- < 10
- 10-20
- 20-30
- 30-40
- >40

Weathered & Fractured Zone in Hardrock Area:

- <10
- 10-20
- 20-30
- 30-40
- 40-50
- 50-60
- 60-70
- 70-80
- 80-90
- 90-100
- > 100

CROSS SECTIONS

BANAS RIVER BASIN

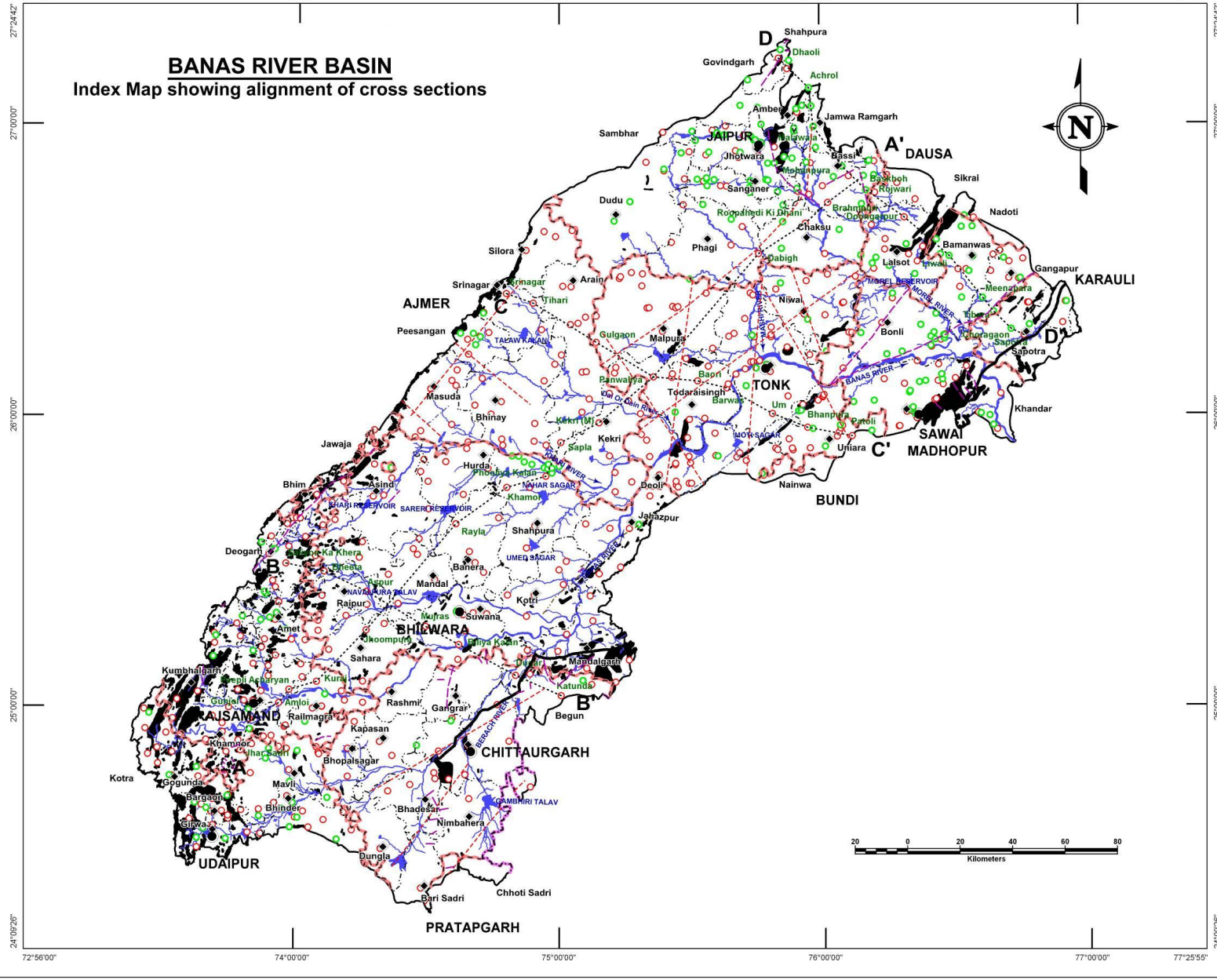
Cross sections are pictorial representation of sub surface disposition of litho-stratigraphic units occurring in the study area. To decipher the sub surface disposition of lithounits several cross sections have been prepared depicting the occurrence, extent and thickness of individual lithounits. These cross section gives fair idea about the disposition and occurrence of various aquifer systems, which can further be inferred into the aquifer geometry of the area. The alignment of the cross sections is shown in Plate – XVIII and corresponding sections are presented in Plates – XIX to – XXII. The broad alignment of the sections is as given below:

Name of Section Line	Orientation
Section AA’	SW – NE
Section BB’	NW – SE
Section CC’	NW – SE
Section DD’’	NW – SE

PLATE - XVIII

BANAS RIVER BASIN

Index Map showing alignment of cross sections



Legend

- District Headquarter
- Block Headquarter
- State Boundary
- District Boundary
- Block Boundary
- River Basin Boundary
- Fault
- Great Boundary Fault
- Lineament
- Shear
- Thrust
- Section Line
- Major Streams / River
- Pond / Reservoir
- Hills / Hilly Forest

Exploratory Wells

- Um — Well location for Sections
- CGWB
- RGWD

Section A-A':

The A-A' section is the longest (about 220 km along the basin length) of the sections plotted in the area and trends in SW-NE direction. Lithologs of 16 bore wells and their surroundings is taken into consideration for the preparation of this cross section. The section depicts the layers of gneiss, pegmatite, schist and amphibolites. On perusal of the cross section, it is apparent that in the south western part of the profile gneiss is found as we move towards NE schist is encountered again in the centre of the profile gneiss is found. In north eastern part quartzite and clay is also found. Gneiss is the bed rock in the profile.

The water level varies from 295 m amsl to 575 m amsl following the surface topography as observed from the 2010 pre monsoon season.

Section B-B':

The B-B' section is 100 km in length rending NW-SE in the southern part of the basin as shown in Plate – XX. Lithologs of 7 bore wells and their surroundings is taken into consideration for the preparation of this cross section. The section is depicting gneiss, schist and shale. In the south eastern part of the section, in one the wells schist is intermitted in gneiss. In extreme south east shale is encountered. Gneiss is the bedrock in the profile.

It is observed from pre monsoon 2010 data the ground water level varies from 400 m amsl to 620 m amsl.

PLATE - XIX

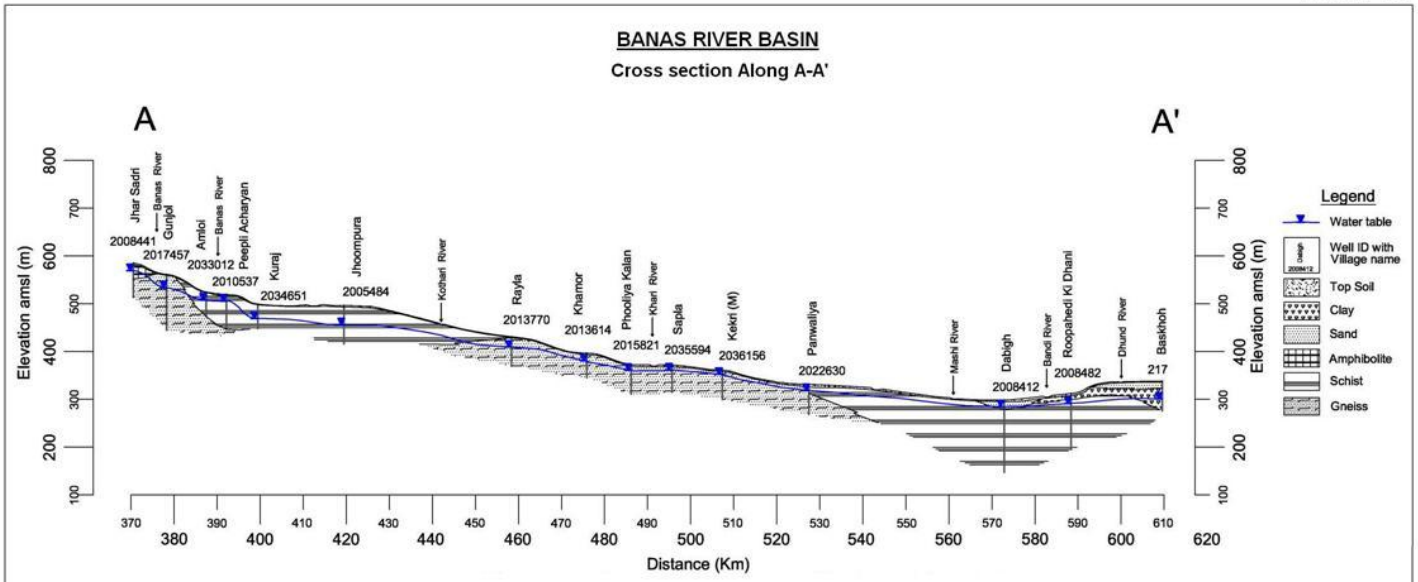
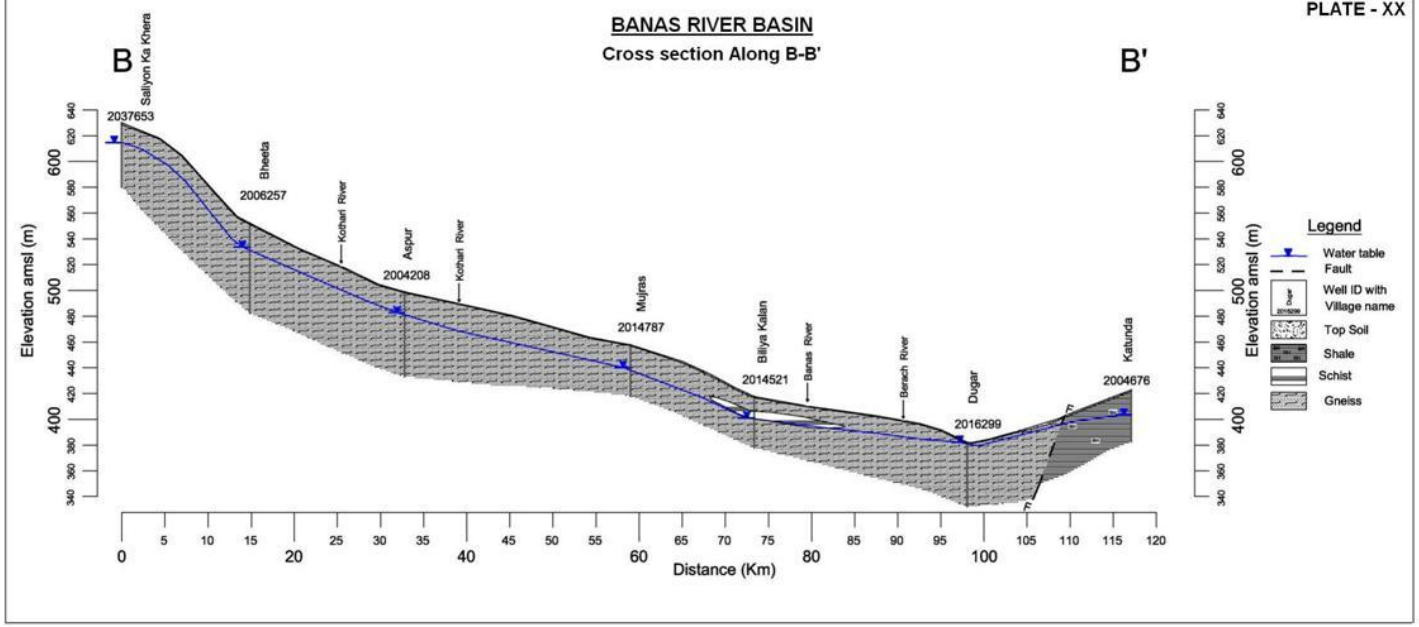


PLATE - XX



Section C-C':

The C-C' section is 140 km long trending NW-SE in the northern part of the basin (PLATE-XXI). Lithologs of 9 bore wells and their surroundings is taken into consideration for the preparation of this cross section. The NW part of the section is characterized by dominance of Gneiss while schist is dominant in the SE part underlain by sand. The weathered and fractured portions of gneiss and schist are most suitable aquifer zones.

The water level varies from 260 m amsl to 425 m amsl as per the data of pre monsoon 2010.

Section D-D':

The D-D' section is 140 km long trending in NE-SW direction selected in the northern part of the basin, Plate – XXII. Lithologs of 11 bore holes and their surroundings is taken into consideration for the preparation of this cross section. The cross section depicts mainly the alternating layers of clay and sand with schist, granite, quartzite and pegmatite encountered in the bottom of the well. In this area alluvium acts unconfined aquifer as well as semi confined to confined aquifer due to continuous and thick impermeable layer of clay mixed with kankar overlying on it.

PLATE - XXI

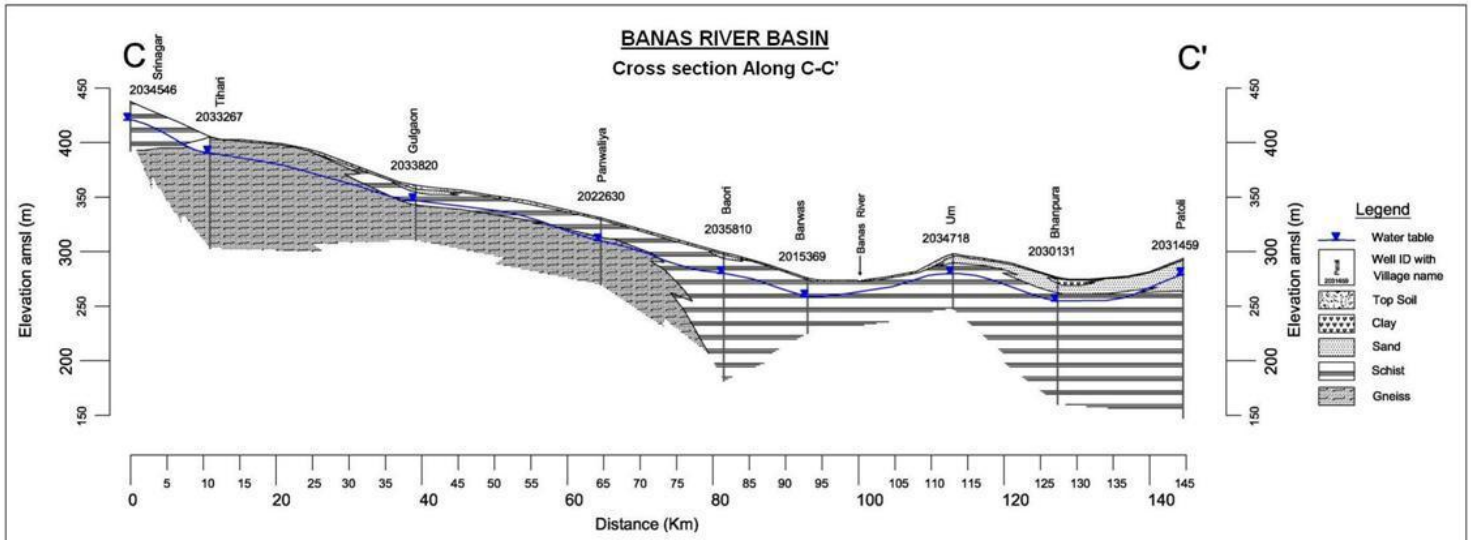
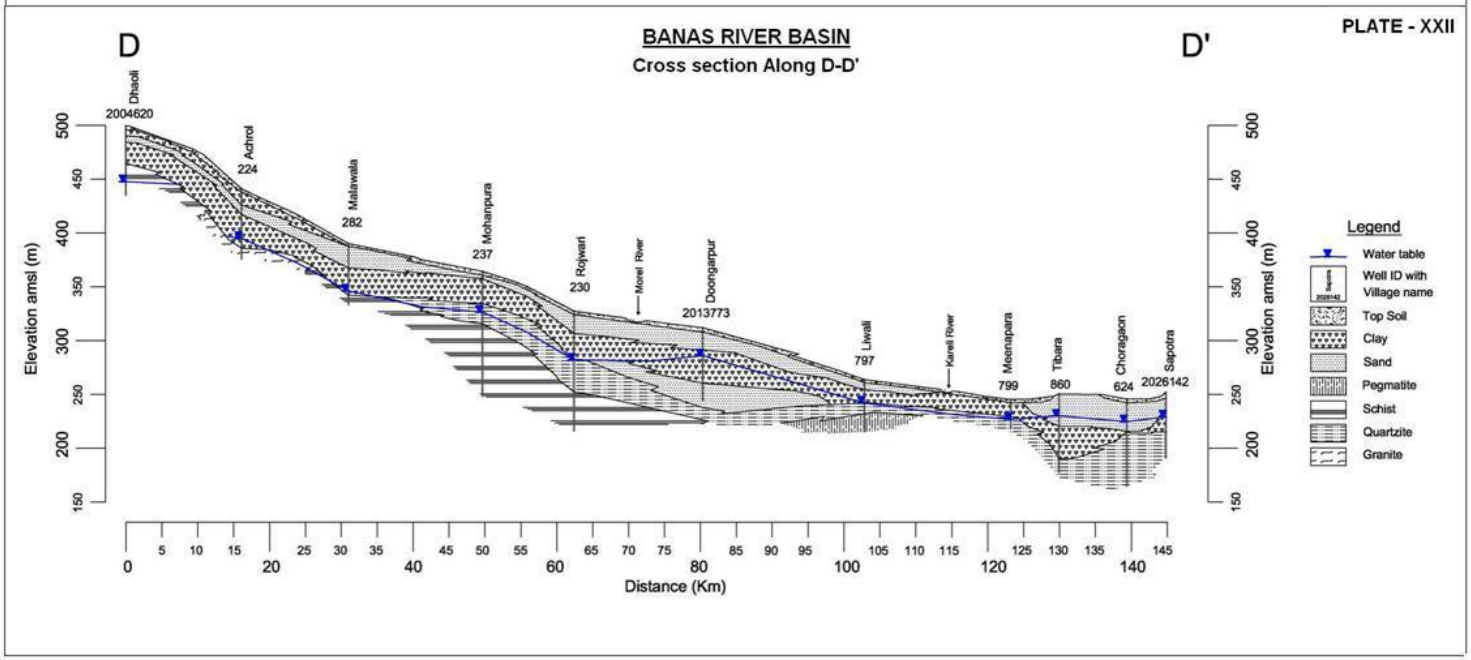


PLATE - XXII



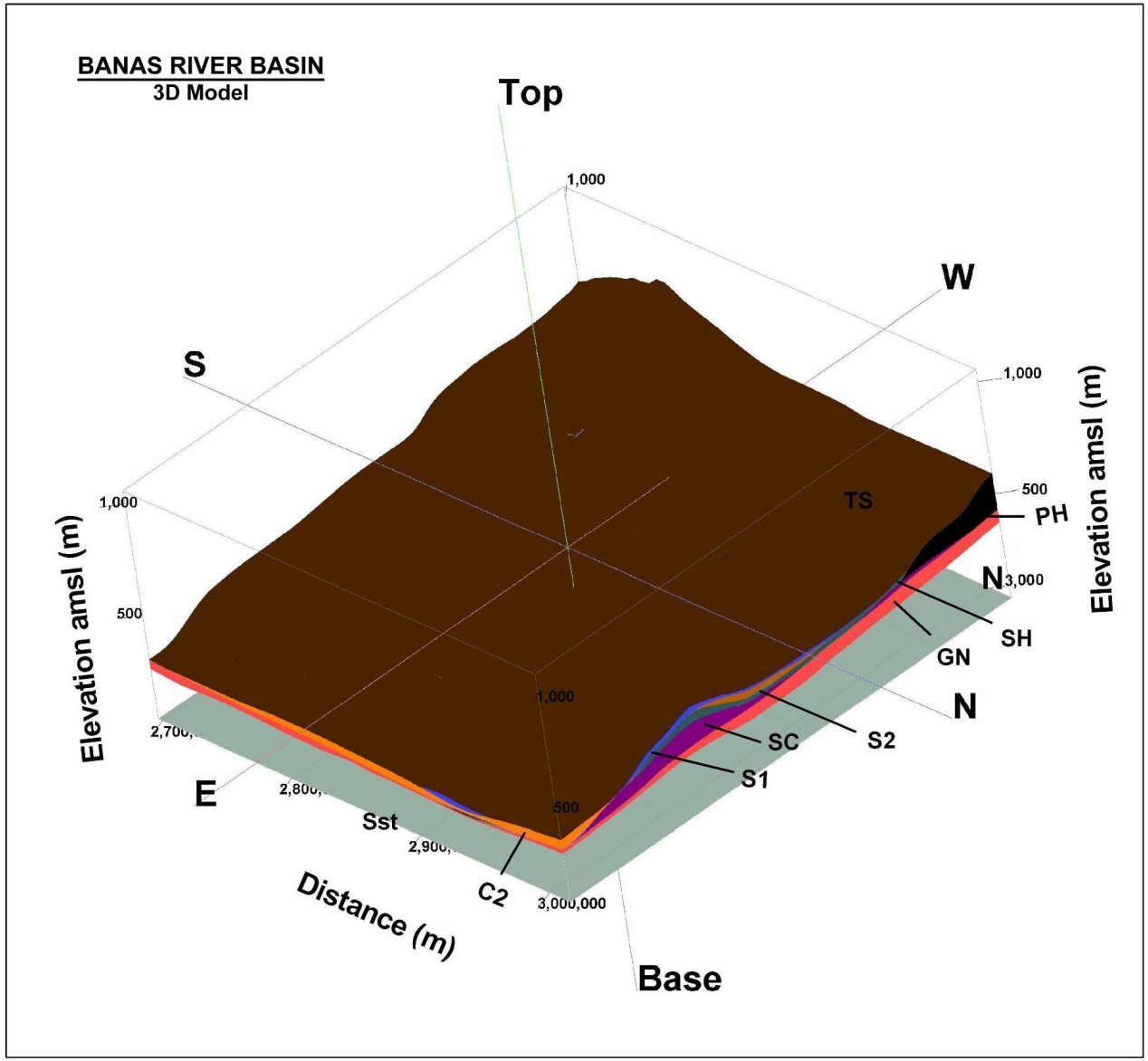
3D MODEL OF AQUIFERS

BANAS RIVER BASIN

The continuous litho-stratigraphic model has been developed for the Banas River Basin using the data of well distributed exploratory tubewells as input. 3D model depicts the sub-surface aquifer disposition of litho-stratigraphic units forming aquifers, aquicludes and aquitards in the area. Plate – XXIII presents 3D model depicting the various litho-stratigraphic units in the entire river basin. With this model it is apparent that gneisses constitute the basement over which other metamorphic and sedimentary formations lie, is a largely continuous formation in the area overlain by schists, phyllites and quartzites. The latter is finally overlain by a cover of alluvium of varying thicknesses.

A Thin cover of top soil is almost always present over the different aquifer materials and alluvium with sand and clay as its major constituents occurs in northern part of the basin. The hard rocks contain water when they are fractured or weathered and are present in most parts of the basin.

PLATE - XXIII



Legend

TS	Top Soil
S1	Sand
C1	Clay
S2	Sand
C2	Clay
WFZ	Weathered & Fractured Zone
LS	Limestone
SH	Shale
Q	Quartzite
	Phyllite
SC	Schist
GN	Granite Gneiss

Glossary of terms

S. No.	Technical Terms	Definition
1	AQUIFER	A saturated geological formation which has good permeability to supply sufficient quantity of water to a Tube well, well or spring.
2	ARID CLIMATE	Climate characterized by high evaporation and low precipitation.
3	ARTIFICIAL RECHARGE	Addition of water to a ground water reservoir by man-made activity
4	CLIMATE	The sum total of all atmospheric or meteorological influences principally temperature, moisture, wind, pressure and evaporation of a region.
5	CONFINED AQUIFER	A water bearing strata having confined impermeable overburden. In this aquifer, water level represents the piezometric head.
6	CONTAMINATION	Introduction of undesirable substance, normally not found in water, which renders the water unfit for its intended use.
7	DRAWDOWN	The drawdown is the depth by which water level is lowered.
8	FRESH WATER	Water suitable for drinking purpose.
9	GROUND WATER	Water found below the land surface.
10	GROUND WATER BASIN	A hydro-geologic unit containing one large aquifer or several connected and interrelated aquifers.
11	GROUND WATER RECHARGE	The natural infiltration of surface water into the ground.
12	HARD WATER	The water which does not produce sufficient foam with soap.
13	HYDRAULIC CONDUCTIVITY	A constant that serves as a measure of permeability of porous medium.
14	HYDROGEOLOGY	The science related with the ground water.
15	HUMID CLIMATE	The area having high moisture content.
16	ISOHYET	A line of equal amount of rainfall.
17	METEOROLOGY	Science of the atmosphere.
18	PERCOLATION	It is flow through a porous substance.
19	PERMEABILITY	The property or capacity of a soil or rock for transmitting water.
20	pH	Value of hydrogen-ion concentration in water. Used as an indicator of acidity (pH < 7) or alkalinity (pH > 7).
21	PIEZOMETRIC HEAD	Elevation to which water will rise in a piezometers.
22	RECHARGE	It is a natural or artificial process by which water is added from outside to the aquifer.
23	SAFE YIELD	Amount of water which can be extracted from ground water without producing undesirable effect.
24	SALINITY	Concentration of dissolved salts.
25	SEMI-ARID	An area is considered semiarid having annual rainfall between 10-20 inches.
26	SEMI-CONFINED AQUIFER	Aquifer overlain and/or underlain by a relatively thin semi-pervious layer.
27	SPECIFIC YIELD	Quantity of water which is released by a formation after its complete saturation.
28	TOTAL DISSOLVED SOLIDS	Total weight of dissolved mineral constituents in water per unit volume (or weight) of water in the sample.

(Contd…)

S. No.	Technical Terms	Definition
29	TRANSMISSIBILITY	It is defined as the rate of flow through an aquifer of unit width and total saturation depth under unit hydraulic gradient. It is equal to product of full saturation depth of aquifer and its coefficient of permeability.
30	UNCONFINED AQUIFER	A water bearing formation having permeable overburden. The water table forms the upper boundary of the aquifer.
31	UNSATURATED ZONE	The zone below the land surface in which pore space contains both water and air.
32	WATER CONSERVATION	Optimal use and proper storage of water.
33	WATER RESOURCES	Availability of surface and ground water.
34	WATER RESOURCES MANAGEMENT	Planned development, distribution and use of water resources.
35	WATER TABLE	Water table is the upper surface of the zone of saturation at atmospheric pressure.
36	ZONE OF SATURATION	The ground in which all pores are completely filled with water.
37	ELECTRICAL CONDUCTIVITY	Flow of free ions in the water at 25C mu/cm.
38	CROSS SECTION	A Vertical Projection showing sub-surface formations encountered in a specific plane.
39	3-D PICTURE	A structure showing all three dimensions i.e. length, width and depth.
40	GWD	Ground Water Department
41	CGWB	Central Ground Water Board
42	CGWA	Central Ground Water Authority
43	SWRPD	State Water Resources Planning Department
44	EU-SPP	European Union State Partnership Programme
45	TOPOGRAPHY	Details of drainage lines and physical features of land surface on a map.
46	GEOLOGY	The science related with the Earth.
47	GEOMORPHOLOGY	The description and interpretation of land forms.
48	PRE MONSOON SURVEY	Monitoring of Ground Water level from the selected DKW/Piezometer before Monsoon (carried out between 15th May to 15th June)
49	POST-MONSOON SURVEY	Monitoring of Ground Water level from the selected DKW/Piezometer after Monsoon (carried out between 15th October to 15th November)
50	PIEZOMETER	A non-pumping small diameter bore hole used for monitoring of static water level.
51	GROUND WATER FLUCTUATION	Change in static water level below ground level.
52	WATER TABLE	The static water level found in unconfined aquifer.
53	DEPTH OF BED ROCK	Hard & compact rock encountered below land Surface.
54	G.W. MONITORING STATION	Dug wells selected on grid basis for monitoring of state water level.
55	EOLIAN DEPOSITS	Wind-blown sand deposits

Ground Water Department,
Rajasthan

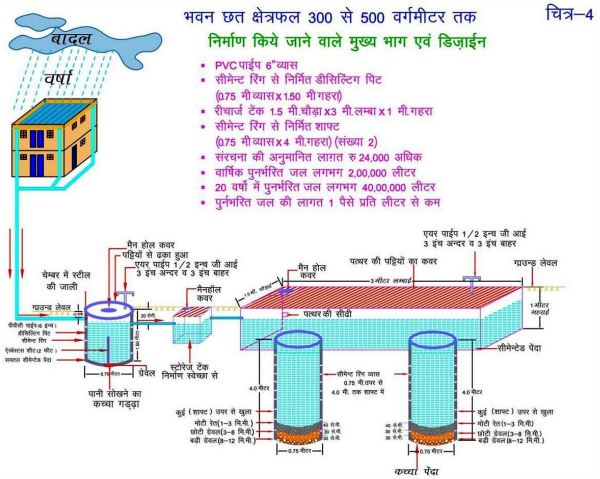
European Union
State Partnership Programme

चित्र–4

भवन छत क्षेत्रफल 300 से 500 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

- PVC पाईप 6" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट
  (0.75 मी.व्यास x 1.50 मी.गहरा)
- रीचार्ज टेंक 1.5 मी.चौड़ा x 3 मी.लम्बा x 1 मी.गहरा
- सीमेन्ट रिंग से निर्मित शाफ्ट
  (0.75 मी.व्यास x 4 मी.गहरा) (संख्या 2)
- संरचना की अनुमानित लाग़त रु 24,000 अधिक
- वार्षिक पुनर्भरित जल लगभग 2,00,000 लीटर
- 20 वर्षों में पुनर्भरित जल लगभग 40,00,000 लीटर
- पुर्नभरित जल की लागत 1 पैसे प्रति लीटर से कम

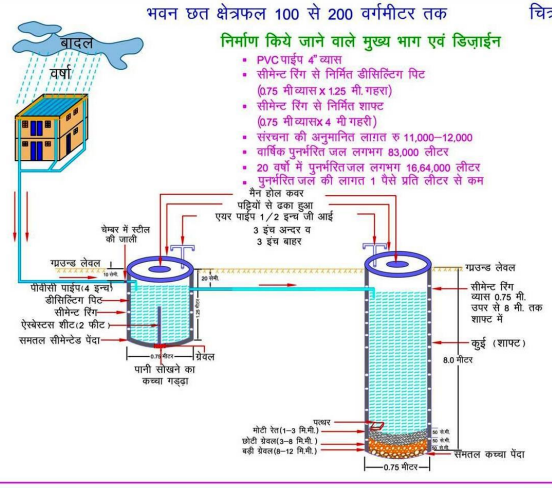


चित्र–2

भवन छत क्षेत्रफल 100 से 200 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

- PVC पाईप 4" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट
  (0.75 मी.व्यास x 1.25 मी.गहरा)
- सीमेन्ट रिंग से निर्मित शाफ्ट
  (0.75 मी.व्यास x 4 मी.गहरी)
- संरचना की अनुमानित लाग़त रु 11,000–12,000
- वार्षिक पुनर्भरित जल लगभग 83,000 लीटर
- 20 वर्षों में पुनर्भरित जल लगभग 16,64,000 लीटर
- पुनर्भरित जल की लागत 1 पैसे प्रति लीटर से कम

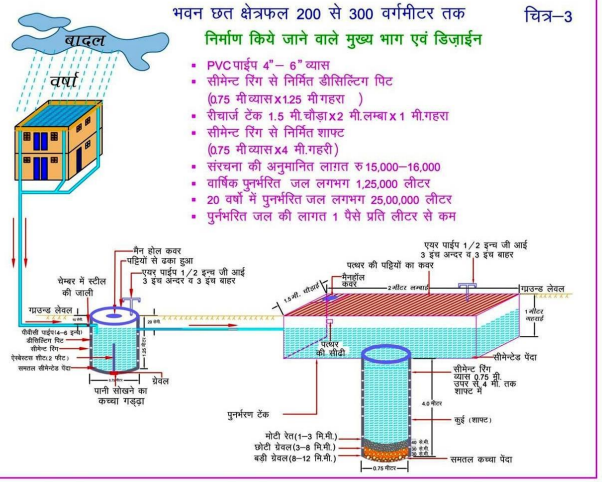


चित्र–3

भवन छत क्षेत्रफल 200 से 300 वर्गमीटर तक

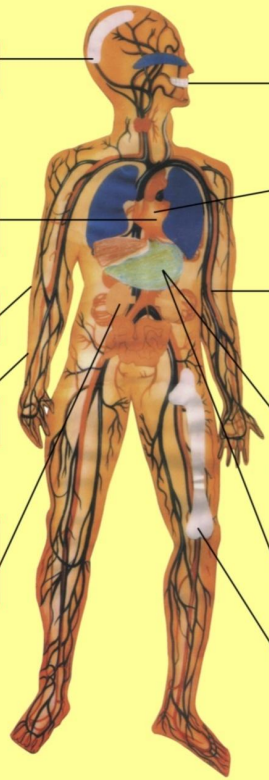
निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

- PVC पाईप 4" – 6" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट
  (0.75 मी.व्यास x 1.25 मी.गहरा)
- रीचार्ज टेंक 1.5 मी.चौड़ा x 2 मी.लम्बा x 1 मी.गहरा
- सीमेन्ट रिंग से निर्मित शाफ्ट
  (0.75 मी.व्यास x 4 मी.गहरी)
- संरचना की अनुमानित लाग़त रु 15,000–16,000
- वार्षिक पुनर्भरित जल लगभग 1,25,000 लीटर
- 20 वर्षों में पुनर्भरित जल लगभग 25,00,000 लीटर
- पुर्नभरित जल की लागत 1 पैसे प्रति लीटर से कम



भूजल में घुले मुख्य तत्वों की अधिकता का मानव शरीर पर दुष्प्रभाव

- बोरोन-स्नायु तन्त्र पर प्रभाव
- क्लोराइड-सोडियम के साथ मिलकर उच्च रक्त चाप
- कैल्शियम-जोड़ों में कड़ापन
- आर्सेनिक-त्वचा रोग, कैंसर
- लेड-बच्चों के शारीरिक व मानसिक विकास में बाधा वयस्कों में गुर्दे के रोग



- फ्लोराइड - दंत क्षरण
- सोडियम-हृदय, गुर्दा व रक्त परिसंचरण रोगों से ग्रसित लोगों को हानिकारक
- नाइट्रेट-नवजात शिशुओं में ब्लू बेबी बीमारी (मेथमोग्लोबिनिमिया)
- सल्फेट-अधिकता में मैग्नेशियम के साथ मिलकर दस्तावर
- आयरन-आयरन जीवाणु से आमाशय संबंधी रोग
- फ्लोराइड-जोड़ों में अकड़न, हड्डियों में मुड़ाव

केन्द्रीय भूमि जल बोर्ड,
पश्चिमी क्षेत्र, जयपुर
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भूजल अमूल्य है इसे प्रदूषित न करें।

चित्र–1

भवन छत क्षेत्रफल 100 वर्गमीटर तक

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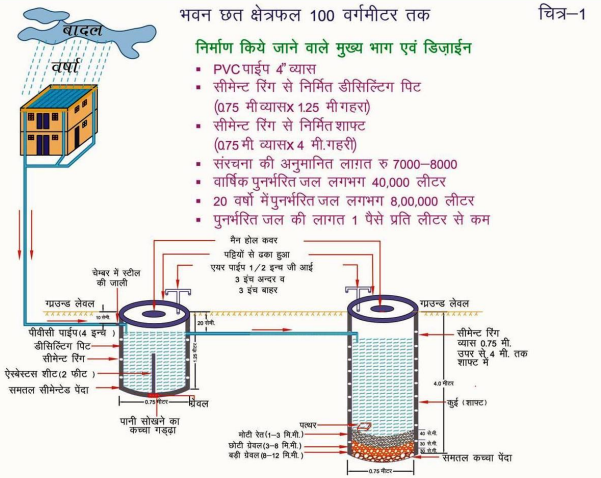
  (0.75 मी.व्यास x 4 मी.गहरी)
- संरचना की अनुमानित लाग़त रु 7000–8000
- वार्षिक पुनर्भरित जल लगभग 40,000 लीटर
- 20 वर्षों में पुनर्भरित जल लगभग 8,00,000 लीटर
- पुनर्भरित जल की लागत 1 पैसे प्रति लीटर से कम



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Myths and Facts about Ground Water

S No	Myths	Facts
1	What is Ground Water • an underground lake • a net work of underground rivers • a bowl filled with water	Water which occurs below the land in geological formations/rocks is Ground water
2	Ground Water occurs everywhere beneath the Land Surface	Not really, it depends on the nature of rock formation
3	There is a relationship between ground water and surface water	Not all the places. Near streams/rivers there is relation
4	Groundwater is not renewable resource	It is renewable source and every year it is being recharged through rain/applied irrigation etc
5	Ground water is unlimited and deeper you drill more discharge	It is limited to annual recharge from rain/applied irrigation. The discharge may not increase if you go deeper
6	Ground Water moves rapidly	The movement of ground water is very slow
7	Ground water pumped from wells is thousands of years old	Generally the ground water being tapped through wells is a few years old
8	If water taste good—it is safe to drink	It may have other chemicals e.g. fluoride, nitrates etc which are harmful
9	Water from free flowing tube wells is very pure	This water can also be contaminated so test before use
10	If I recharge my TW/DW/HP it will not benefit me	It will also benefit you and also adjoing wells
11	There is no static ground water resources in Rajasthan	Rajasthan is also having Static GW resources, and being tapped in most of areas as GW annual withdrawal is more than annual recharge
12	I cannot meet annual cooking and drinking water requirement by rain water harvesting	The water requirement for drinking and cooking is only 8 lit/day. You can harvest this water for family of 5 persons from roof top or paved area of 75 Sq m to meet annual requirement
13	You can increase ground water recharge	This can be done by harvesting the rain water and storing in sub surface reservoir (GW) by constructing the recharge structures
14	You cannot use abandoned TW/HP/DW for ground water recharge	These should be used as recharge structures as harvested rain water is directly put into GW reservoir
15	Putting waste near HP/TW will not cause any problem	Such actions will pollute wells and water

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